THE

BULLETIN

Hydro-Electric Power
Commission of Ontario

JANUARY [illegible]

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VOL. XIII NO. 1-12

Hydro-Electric Power Commission of Ontario

JANUARY 1926
- DECEMBER

Aubrey Falls, Mississaga River.

HYDRO MUNICIPALITIES

CENTRAL ONTARIO SYSTEM

	Pop.
Belleville	12,803
Bloomfield	550
Bowmanville	3,447
Brighton	1,375
Camden East Twp	2,982
Cobourg	5,459
Colborne	829
Darlington Twp	3,407
Deloro	298
Deseronto	1,928
Havelock	1,266
Kingston	22,368
Lakefield	1,146
Lindsay	7,840
Madoc	1,078
Marmora	853
Millbrook	733
Napanee	2,992
Newcastle	619
Newburgh	434
Norwood	711
Omemee	557
Orono	700
Oshawa	16,059
Peterboro	21,790
Pickering Twp	4,382
Picton	3,189
Port Hope	4,567
Richmond Twp	1,944
Seymour Twp	2,506
Stirling	778
Trenton	5,881
Tweed	1,268
Warkworth	
Wellington	850
Whitby	4,131
Whitby Twp	1,785
Whitby E. Twp	3,747
Total	147,252

GEORGIAN BAY SYSTEM

Alliston	1,301
Alton	450
Artemesia Twp	2,316
Arthur	1,218
Barrie	6,876
Beaverton	975
Beeton	580
Bradford	1,028
Brant Twp	
Brechin	225
Brock Twp	2,795
Cannington	896
Chatsworth	326
Chesley	1,803
Coldwater	663
Collingwood	6,237
Cookstown	635
Creemore	603
Derby Twp	1,507
Dundalk	690
Durham	1,622
Eldon Twp	2,047
Elmva'e	600
Elmwood	350
Flesherton	417
Flos Twp	
Gamebridge	70
Grand Valley	595
Gravenhurst	1,621
Hanover	2,842
Holstein	285
Horning's Mills	350
Huntsville	2,316
Kilsyth	
Kincardine	2,156
Kinloss Twp	
Kirkfield	138
Lucknow	918
Mara Twp	2,280
Maraposa Twp	
Markdale	927
Meaford	3,000
Midland	7,129
Mount Forest	1,825
Neustadt	444
Nottawasaga Twp	
Orangeville	2,503
Oro Twp	
Owen Sound	12,360
Paisley	749
Penetang	3,896
Port McNicholl	614
Port Perry	1,142
Priceville	
Reach Twp	
Ripley	670
Shelburne	1,134
Stayner	927
Sunderland	570
Sunnidale Twp	
Tara	597
Tay Twp	
Teeswater	807
Thorah Twp	1,084
Thornton	200
Tottenham	453
Uxbridge	1,492
Victoria Harbor	1,462
Waubaushene	600
Wingham	2,470
Woodville	448
Total	97,234

NIAGARA SYSTEM

Acton	2,000
Agincourt	
Ailsa Craig	535
Alvinston	659
Amherstburg	2,820
Ancaster	400
Ancaster Twp	4,124
Aylmer	2,241
Ayr	796
Baden	710
Barton Twp	6,742
Beachville	503
Belle River	580
Bertie Twp	
Beverly Twp	
Biddulph Twp	1,640
Blandford Twp	
Blenheim Twp	
Blenheim	1,528
Blyth	692
Bolton	656
Bothwell	630
Brampton	4,406
Brantford	32,786
Brantford Twp	7,301
Breslau	500
Brigden	400
Brussels	872
Burford	700
Burford Twp	3,886
Burgessville	300
Caledonia	1,308
Canard River	50
Caradoc Twp	
Chatham	15,525
Chinguacousy Twp	
Chippawa	1,099
Clifford	
Clinton Twp	
Clinton	1,941
Comber	800
Copetown	230
Cottam	333
Courtright	425
Crowland Twp	
Dashwood	350
Delaware Twp	
Delaware	350
Dereham Twp	3,200
Dorchester	400
Dorchester S. Twp	1,436
Dorchester N. Twp	
Dover E. Twp	
Drayton	602
Dresden	1,393
Drumbo	375
Dublin	218
Dumfries N. Twp	
Dumfries S. Twp	
Dundas	5,054
Dunnville	3,569
Dutton	870
Easthope N. Twp	
Easthope S. Twp	
Ekfrid Twp	
Elmira	2,400
Elora	1,199
Embro	463
Essex	1,753
Etobicoke Twp	15,000
Exeter	1,583
Fergus	1,815
Flamboro W. Twp	
Flamboro E. Twp	2,624
Ford City	11,301

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Hydro-Electric Power Commission's Progress During 1925

By Charles A. Magrath, Chairman, H.E.P.C. of Ont.

IN submitting a statement of the outstanding features of the work of the Hydro-Electric Power Commission during the past year, it is a satisfaction to my colleagues and to me to be able to assure the citizens of Ontario that the progress made by their co-operative undertaking during the year has been most gratifying.

Before commenting upon its activities during 1925, the Commission desires again to refer to the very great loss sustained by the organization in the death, on Aug. 15, of Sir Adam Beck, who, since its commencement had so ably and faithfully discharged the duties of Chairman of the Commission. Sir Adam Beck directed the work of the Commission through many trying periods, and with rare foresight and judgment he so guided its affairs that there was probably never a period in the life of the Commission when the whole of its operations were in a more satisfactory and promising condition than they were at the time death caused him to cease his labors. Seldom has public service received more heartfelt and widespread acknowledgement than was accorded to the services rendered by Sir Adam Beck on behalf of the citizens of his native Province.

Heavier Demands for Energy.

During the past year there has been a steady growth in the demand from municipalities for electrical energy, and new equipment has been placed in operation as rapidly as it could be installed. On the Niagara system, Units 8 and 9 have been completed at the Queenston Chippawa plant, which, under test, has carried a peak load of 550,000 horsepower.

A year ago, it was estimated that the load on the Niagara system

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might, during the year, reach about 715,000 horsepower, but this demand has been exceeded, and, under conditions similar to last year, the maximum peak has actually reached 750,000 horsepower. This growth reflects an encouraging improvement in general industrial and commercial conditions, and, should it continue, next year's demand, under similar conditions would reach 800,000 horsepower. The total load served by the Commission during the year for its various systems is about 900,000 horsepower. When it is realized that all the plants that the Commission has under construction will, when fully developed, yield about 1,000,000 horsepower, it is obvious that the remaining margin of security against an oncoming power shortage is even less than it was estimated to be a year ago.

The Commission has in no way slackened in its efforts to find suitable new sources for the supply of electrical energy. The various factors involved in the proposed development of the St. Lawrence, a possible further allotment of water at Niagara, and the possible development of power sites on the interprovincial Ottawa River, are all being most carefully appraised; and wherever a step forward could be made such a step has been taken.

With regard to the progress of the supply of electric light and power to rural districts, it may be stated that there has been a steady growth in this branch of the Commission's work. There are now nearly 14,000 rural consumers served by means of 1,500 miles of primary line. The capital expenditure on behalf of the rural work is about $3,200,000, 50 per cent. of which has been furnished by the Provincial grants-in-aid made for this specific purpose in accordance with the Ontario Government's policy to stimulate agricultural development.

Georgian Bay System.

It will be recalled that the various systems originally known as the Severn,Eugenia, Wasdell's and Muskoka were combined to constitute the Georgian Bay system. This system serves a territory adjacent to the Georgian Bay extending from Huntsville on the north to Uxbridge and Port Perry on the south and to Kincardine and Lake Huron on the west, and embraces an area approximately equal to the Commission's Niagara system. The past year was the first for the operation of this new consolidated system. The Commission completed the extension to the South Falls generating

station on the Muskoka River, which increases the output of this plant by approximately 3,500 horsepower. An additional extension is partially completed which will provide a new unit of approximately 2,000 horsepower at Hanna Chutes, thus making a combined increased capacity of about 5,500 horsepower on the Georgian Bay system. The total generating capacity serving the Georgian Bay district is about 25,000 horsepower.

CENTRAL ONTARIO'S STEADY INCREASE.

The demand for power on the Central Ontario and Trent system shows a steady normal increase. The total available generating capacity is now a little over 47,000 horsepower, including the two new generating stations at Dams Nos. 8 and 9, on the Trent River, which have a combined rating of about 11,000 horsepower. The Commission is now supplying to the municipalities and customers of the Central Ontario and Trent system nearly double the quantity of power that was supplied when the operation of the system was taken over by the Commission in 1916.

Of the Commission's other systems, the St. Lawrence, the Rideau, the Ottawa and the Nipissing, show increased loads, but there is not margin in the way of additional power to meet the future needs.

GROWING MARKET IN THUNDER BAY.

The development of the power markets in the Thunder Bay district has exceeded the Commission's estimates, and the pronounced demands for additional power stand out in marked contrast to the pessimistic criticism that has been directed against the Commission's activities on behalf of the Thunder Bay district. The load of about 7,000 horsepower, which the Commission had in 1920, has increased until today the Commission is supplying, not only 40,000 horsepower to its own customers, but in addition from 4,000 to 6,000 horsepower to aid the Kaministiquia Power Company to take care of its business in Fort William and vicinity.

The Commission's Port Arthur load is about three and a half times the size it was at the beginning of 1921. The Commission by the installation during the past year of two new units, Nos. 5 and 6, has increased the generating capacity of its plant to 75,000 horsepower, and the plant has already delivered on peak nearly 49,000 horsepower. During the past year a storage dam was constructed at Virgin Falls. The storage facilities thus provided on Lake Nipigon enable the Commission to cope with the high load factors on the Thunder Bay system —factors which during some periods exceed 80 per cent.

During the past year the Commission has constructed for Port Arthur a new terminal station, which includes the most modern 110,000-volt equipment. The demand for additional power is such that the Commission will have to provide a new power development for the Thunder Bay system.

ST. LAWRENCE POWER URGENTLY NEEDED.

In conclusion it may be said that the facts relating to the Commis-

sion's operations as above recorded may be regarded as indicating only the growth that might be expected under general, normal conditions. It has been clear to the Commission that anything like a marked advance in general industry and commerce would evoke power demands that would soon tax all the Commission's developments to the limit. One of the significant features, therefore, of the brief survey here presented is to emphasize the importance of the efforts the Commission has been making to secure the earliest possible development of Ontario's share of the water power in the upper—that is, the international—portion of the St. Lawrence River.

Toast to the Liberal Professions

Address by Arthur Surveyer, Consulting Engineer, Montreal, at the Banquet in honor of Mr. Charles A. Magrath, at Toronto on November 18th, 1925

I FIRST wish to thank the members of the Organization Committee of this Banquet for having given me the opportunity of publicly paying homage to Mr. C. A. Magrath and of offering him, in the name of all the engineers in Canada, our most sincere congratulations on his recent appointment to the Chairmanship of the Hydro-Electric Power Commission of Ontario.

I know that I should feel very embarrassed at the thought of addressing such a notable assembly, in a language which is not my own. But my feeling of embarrassment is partially relieved by the thought that I am to be followed by such eloquent speakers that they will very quickly erase my words from your memory.

Individual success is largely due to a man's character, and to his ability to adapt himself to new conditions over which he has generally no control. Mr. Magrath has been very successful in adapting himself to varying conditions and he has had three brilliant careers in a term of years, which would have been well filled if it had been featured by success in only one sphere of activity. He first began by making his mark as a technician; then, he became a respected parliamentarian and, later, in order to better serve his country, he accepted to sit as a member of the International Joint Commission. I remember, however, that, at the time, his appointment to the Chairmanship of the Waterway Commission created somewhat of a scandal amongst the legal fraternity which was only appeased when the Minister responsible for the appointment, explained, on the floor of the House that Mr. Magrath was an exceptional engineer with a judicial turn of mind.

Not content with having to carry the responsibility of solving our most delicate international problems, Mr. Magrath accepted, during the war, to regulate our fuel supply. It was thanks to his diplomacy, at Washington, that during this most

difficult period, Canada received, from the United States, the fuel necessary to fill our domestic and industrial requirements.

You are apparently, Sir, not satisfied to rest after all these achievements but you are evidently eager for more difficulties to overcome, since you have, now, accepted one of the most important executive positions in Canada, in the Chairmanship of the Hydro-Electric Power Commission of Ontario. Reviewing thus rapidly your career, Sir, it is not surprising that the admiration of all your fellow engineers goes out spontaneously to you and that so many representatives of the liberal professions have assembled here, to-night, to honour you.

Ever since I have been notified that it would be my privilege to propose the toast to the liberal profession I have been endeavouring, in vain, to single out the points which distinguish the members of these professions from the men who have chosen other callings. It was only yesterday that it suddenly dawned upon me that I was attempting to apply the conceptions of the year 1900 to the conditions obtaining in 1925, and that the line of demarcation between the professions and business has become quite faint.

It is true, of course, that the men who elect to study one of the so called learned professions must be classed as idealists since they know beforehand that their satisfactions will be chiefly intellectual and that they cannot hope for more than a competency.

There is no doubt, however, that business men have become more human and professional men more practical. Experience has taught the first that they must give in order to receive, and necessity has compelled the professional men to become materialists in order to survive. No particular calling, therefore, can claim to have the monopoly on hard headedness or on altruism.

The principal difference between the business men and the professional lies in the methods adopted to solve their problems. The first one depends on experience and psychology, the professional man depends on analysis and knowledge. The common characteristics of all professional men, therefore, is their reliance upon the power of the intellect and their ability to apply their minds to the reasoning out of the problems which confront them.

To the members of the liberal professions, society owes all the important things in life:

To the lawyers, we owe the laws which govern us and the enforcement of these laws;

To the doctors, the conservation and lengthening of our life;

To the religious minister, our spiritual comfort;

To the architects, our monuments and our homes, and, speaking in all humility, to the engineers, society owes nearly all the rest.

Gentlemen, I give you—

the lawyers, the dominant figure in our public life;
the doctor, the guardian of our health;
the religious minister, the healer of our spiritual wounds;
the architect and the engineer, the materializers of our dreams.

Hydro-Electric Developement in Canada

Discussions on a paper on this Subject at the Convention of the American Society of Civil Engineers at Montreal, Oct., 14th, 1925

DURING the Fall Meeting of the American Society of Civil Engineers at Montreal, a paper was presented by Mr. Ira W. McConnell, Vice-President, Dwight P. Robinson & Co., New York City, on this subject. The paper was prepared as an argument in favour of the export of power from Canada and is of considerable length. We give herein Mr. McConnell's own summary of the situation as stated at the end of the paper, as follows:

SUMMARY OF SITUATION.

The situation may be summed up as follows:

1. Restriction of export is contrary to the general policy of commercial nations which strive to build up export business in all directions.

2. Restriction of export of hydro power to the United States now because of hypothetical remote future needs of Canada is analogous to a restriction on export of grain at this time because in another generation the population of Canada may consume all grain produced at home. This would obviously be poor business.

3. The favourable location of Canada for export of power due to the nearness of large undeveloped water powers in Canada to industrial districts in the United States is an opportunity for immediate profit to Canada and not a menace to its future prosperity.

4. Value of water power for export is possibly greater now than in the future due to the remarkable increase in thermal efficiency of coal-burning plants, which are continuously being improved.

5. The effect of export of Canadian water power to the United States is to conserve coal and diminish the amount of labour employed in the United States in generating power in mining and transporting coal rather than to materially reduce the cost of power in United States.

6. Waste of United States' coal is detrimental to Canada as well as to United States, because Canada now imports 22,000,000 tons for use in connection with the development of only 15 per cent. of the water powers in Ontario and Quebec, so that it might need to import 150,000,000 tons for use in connection with water power if all water power were developed and used internally. Canada is directly interested in the price of coal, which will rise as the supply becomes exhausted in nearby fields.

7. If shortage of water power in north-eastern United States should ever make manufacturing unprofitable there it would result in shifting manufacturing to the water power districts of the south-east United States or to the Pacific Coast and not to Canada. Some shifting of cotton manufacturing from New England to the south-east is already

taking place primarily due to more favourable labour conditions and also incidentally to more abundant water power.

8. Stagnation in population and importance of the north-east section of the United States adjacent to Canada would adversely affect the trade and prosperity of Ontario and Quebec, which are now stimulated by being near to large markets.

In the discussion following the paper, Messrs. Julian C. Smith, H. G. Acres, and F. A. Gaby presented the other side of the situation and we give herein those discussions:

Discussion

By Julian C. Smith, Vice-President and General Manager, Shawanigan Water and Power Company, Montreal, Que.

FROM an engineering standpoint there is no more important question before the Canadian public than the conservation of the unrivalled water power resources of the Dominion. One phase of the conservation question that has been causing considerable apprehension in Central Canada is the increasingly urgent appeals from across the border for Canadian power. These appeals, made by very influential interests, have been so ably presented that the Governments concerned have been forced to give the whole question of power exportation most careful consideration. It has been debated in the Federal Parliament and in the Legislatures of Quebec and Ontario and with unanimous conclusions. It has occupied a leading place in the news columns and editorial pages of our Press. As a result, I think it can be conservatively said that the great bulk of public opinion is against the exploitation of Canadian power for exportation purposes.

Because there is still some misunderstanding regarding the reasons for the attitude of the Canadian people and of the conclusions of their Governments against exportation, it is well that the question has been raised at this time in such a capable manner by a distinguished member of the Society. It should result in the dispelling of many erroneous ideas of the water power resources of Central Canada. I hope it will also enable an appreciation of the main reasons for the decisive declarations of policy on the part of the interested Governments that the limited power reserves of the Provinces of Ontario and Quebec must be conserved for national needs.

Mr. McConnell's paper is a very clear exposition of the point of view of the American promoter of hydro-electric enterprises, of the relation between Canadian water power and industrial progress within the international geographical area comprising the Provinces of Ontario and Quebec and the Northeastern States of the Union. By a synoptical summary of the exchange of commodities across the International Boundary, he attempts to show that Canada has realized such advantages with resultant obligation that the Dominion should perforce permit the

exploitation of her water powers for temporary exportation purposes. He elaborates a theory that because there is an overplus of power in the Provinces of Quebec and Ontario that may not be needed in the Dominion for generations, it would not only be good business for Canada to permit its temporary exportation to the United States, but that by so doing, the Dominion would be discharging an economic obligation to a friendly neighbour from whom coal and petroleum products have been secured in generous quantities.

Few, familiar with the tariff barriers imposed by the United States will agree that trade between the two countries has been upon any other basis than one dictated by the best interests of the wealthier and more populous nation. Tabular statements indicating the extent and character of the mutual imports and exports of the two countries do not disclose where trade advantages lie. Mr. McConnell's diagrams very clearly indicate that since 1912 the balance of trade has greatly favoured the United States. Although our population is one-twelfth that of the United States, our imports have greatly exceeded our exports. A study of Mr. McConnell's tables and graphs in the light of tariff handicaps should absolve Canada of the claim that she is under an economic obligation to her neighbor.

Pointed reference has been made to the dependence of Central Canada upon the United States for fuel. The Provinces of Ontario and Quebec, having no native supplies, must import coal. Until recently the bulk of their supply has come from the South, and without interruption notwithstanding fuel crises in the United States. Canadians are grateful for the consideration given them during these critical periods. It has been generally and generously admitted that American authorities have considerately treated Canada's needs. Because of the dislocation of industry and the extensive suffering of the people caused by strikes in the American coal areas, the Government of Canada has created a Federal Fuel Board which is slowly but surely evolving a National Fuel Policy designed to make the central Provinces less dependent upon foreign fuels. It is reasonable to expect that in time the Board's efforts will at least prevent increases in present importations, notwithstanding growth in population. By suitable cokeing of bituminous coals; by the importation of British coal; by a greater use of Canadian coals from the Western and Maritime Provinces; by the substitution of hydro for steam generated energy, the Provinces of Ontario and Quebec will, in course of time, become less dependent upon American fuels. Furthermore, the hydro-electric power now exported in large quantities to the United States and which, by the way, it was not practicable even during the Great War to recover for use in Canada, should prove a *quid pro quo* at any rate for American anthracite. The very fact that the Provinces of Ontario and Quebec have no coal makes it imperative that their great heritages of white coal be conserved. The people of Central Canada would indeed be in a sorry plight if twenty-five years

hence their continued industrial development and domestic comfort were not only dependent upon the availability of American coal, but also upon the return of their own exported hydro power.

Mr. McConnell's main conclusions are based upon three outstanding fallacies:

(1) That there is a huge surplus of hydro power in Central Canada beyond the anticipated needs of the Provinces of Ontario and Quebec.

(2) That it would be good business for Canada to permit the temporary exportation of this surplus power upon long term contracts.

(3) That power so exported can be recovered if it is ever needed in Canada.

1. Central Canada Has Not Unlimited Hydro Power. On the Contrary, While Generously Endowed, Her Resources Will Be Required for Her Own Use Within a very Limited Period—from Fifteen to Twenty-Five Years.

Mr. McConnell's analysis of the quantity of power available in the Central Provinces is made without due regard to the location or other limiting characteristics of this water power. No practical conclusions can be drawn from prognostications of power utilization based upon a quantity of theoretically available power, the largest proportion of which for various reasons is not commercially available. For instance, he asserts that the total hydro electric resources of Quebec and Ontario approximates 11,865,000 24 hour power, justifying an ultimate plant installation of 24,000,000 h.p.

The 11,865,000 h.p. is the theoretic amount estimated by the Dominion Water Power Branch as available for the entire area of the two Provinces including their hinterlands. The same organization has recently made a careful review of the water power resources in the St. Lawrence Basin (within 300 miles of the cities of Toronto and Montreal) which discloses the following undeveloped water power still available:

(a) Including the St. Lawrence River power—6,391,000 h.p.

(b) Excluding the St. Lawrence River power—3,187,000 h.p.

These figures include a large number of widely scattered sites, the greater part of which are of small capacity and many of them are at a considerable distance from industrial centres in Canada and from the international boundary. Sites of less capacity than 25,000 h.p. total 1,150,000 h.p. Upon a conservative basis there cannot be considered to be available in that portion of Ontario and Quebec from which power might be exported to the United States more than the following attractive undeveloped water power capacity:

(a) 4,891,000 h.p. including the St. Lawrence River.

(b) 1,687,000 h.p. excluding the St. Lawrence River.

A careful analysis of this power with due regard to the physical characteristics of sites, their location, their capital cost per h.p., their relation to the pulp and paper, the mining and the electro-chemical industry, to navigation, and having in mind the delays inherent in the

consummation of treaty agreements respecting international waters, indicates that our public utility systems will experience a serious power shortage in Ontario within fifteen years and in Quebec within thirty years.

If the combined power requirements of the two Provinces are met without regard to Provincial boundaries, all the available and economically feasible power sites within striking distance of the International Boundary will be under development well within twenty-five years to meet wholly Canadian requirements. Within a generation, therefore, Canada, instead of having surplus power, will be contending with serious power shortages.

2. It Would Not Be Good Business for Canada to Permit the Exploitation of Her Water Powers for Exportation.

There are a few even on this side of the boundary who believe that the benefit to Canada in the immediate future from huge capital expenditures with the temporary employment of large numbers upon construction work outweighs the problematical danger of losing control of power export.

In my opinion the declared policy of the Governments of Central Canada in favour of the Canadian power for Canada will but temporarily postpone the advantages which flow from the prosecution of large construction operations and the few years of delay involved in postponing development until it is dictated by Canadian needs will be amply repaid by the far greater advantages that go with the combined development and domestic utilization of hydro power.

The benefit derived from the actual construction of the water power plant is almost negligible compared with the benefits which accrue from the application of its energy, and from the resultant increase in industry within the country wherein it is utilized.

The expenditure and temporary work involved in the development of a power site is fairly well understood. The permanent demand for raw material, machinery and manufactured products and the permanent employment supplied by the application of this power are not so fully understood. An intensive study of these, aided by a special census was recently carried out in the United States, the results of which indicated that the development of each 1,000 horsepower of water power called for an expenditure of some $250,000.00 for plant, machinery, transmission and distribution; while the application and use of this power in houses and other buildings and in factories and other industries necessitated an ultimate investment of $1,611,000.00 and involved the support of 2,200 persons. The following table briefly summarizes the results of this investigation.

This table illustrates very concretely the minor advantages which accrues to Canada from the development of power for export compared with the major advantage which accompanies the development of power for utilization. Even assuming that Canada received a stated revenue per horse power from the power exported, the total amount so received would be

	Investment	Employees	Wages
Development	$ 250,000	8.6	$ 13,350
Application	1,611,000	376.4	557,750
Total	$1,861,000	385.0	$571,100

negligible in comparison with the direct results secured from the useful application and exploitation of the energy within her own borders.

The export of power will, on the scale desired by American promoters, provide the United States with a supply of low priced energy which will serve to build up industrial communities in direct competition with our Canadian centres.

As long as we retain our low priced energy within our borders it provides an incentive to those industries to which low priced power is a primary requisite, to locate on the north side of the International Boundary. Witness the recent establishment in Canada of huge electro-chemical and metallurgical industries in the Saguenay district. So long as these industries have any assurance that they can receive this power by means of its exportation from Canada, there will be no incentive for them to move into Canada.

If the interests benefitting by the exportation of electrical energy are encouraged by the addition of further blocks of power, there is grave danger that a momentum will develop which will prove difficult to control, and perhaps impossible to stop. One has only to consider the tremendous growth in power consumption in Ontario during the past two years following the placing in operation of the Queenston plant—a growth which has greatly exceeded the most optimistic earlier calculations of the Hydro-Electric Commission—to realize the enormous absorbing power of the densely populated and highly industrialized Eastern States. Encourage this market by blocks of low priced power and an intensive pressure for further supplies will immediately develop. Canada's entire reserves would, under these conditions, rapidly disappear.

3. Exported Power Cannot be Recovered.

Notwithstanding Mr. McConnell's assurance that aptly worded contractual obligations supported by international conventions will assure the return of power at the termination of forty year contracts, it would be unreasonable to expect that such power will be recovered. Experience has shown the futility of relying upon the recovery of hydro electric energy transmitted to the United States even under the yearly license system that has been in vogue since 1907. Neither the character of the contract nor pertinent international commitments will govern the return of power. Vast vested interests must inevitably be built up, based upon the utilization of power which cannot be ignored, and these interests will always be in a strong position to prevent the stoppage of supply.

Briefly and In Conclusion I Affirm—

(1) In the territory from which it would be feasible to transmit power to New York and New England industrial areas, there is not sufficient commercial water power to prevent serious power shortages in Central Quebec and Southern Ontario within a generation.

(2) If the most desirable and largest water powers in Central Canada are developed primarily for exportation purposes, the industrial progress of this country will be thwarted.

(3) It will never be practicable to recover such power.

I am not one of those who advocate that under no circumstances should any further hydro electric energy be exported from Canada, nor do I consider a Canadian embargo on existing exportations a feasible policy. I believe it is possible to arrive at some acceptible formula for a reciprocal arrangement between the two countries respecting power from international rivers to the end that the pressing power needs of contiguous territory be met. One source of a satisfactory solution of the power needs of New England and New York lie in the enormous potentialities of the Niagara and St. Lawrence rivers. As the Dominion has given ample evidence of its desire to constructively co-operate with the United States in securing the best use of their jointly owned water powers it cannot be said that Canada is unmindful of the obligations and opportunities that accompany proximity to a great and friendly neighbor.

Discussion

By H. G. Acres, Consulting Engineer, Niagara Falls, Ont.

OCCASIONALLY an issue arises which attracts general public interest, and which progresses through various stages of argument until the parties to the controversy arrive at a point where settled convictions are so definitely annunciated as to preclude further argument. In Canada the much debated issue of public versus private ownership has arrived at this stage, and the controversy relative to the export of hydro-electric power from Canada to the United States seems destined to achieve the same status. Governmental authority at least has expressed itself on the subject in terms which leave little room for argument.

In its essentials, Mr. McConnell's paper is non-technical, and it was obviously not prepared for the instruction of the membership of the American Society of Civil Engineers along purely professional lines. It is, on the other hand, a well conceived and ably expressed exposition of a current public issue, prepared by a United States citizen for the purpose of influencing public opinion in Canada and the United States. Mr. McConnell has therefore enacted the role of a propagandist, and the

fact that he is an engineer is merely incidental, as is also the fact that his arguments in favor of the export of power from Canada reached the public through the agency of an engineer's convention. It is to be understood that the word "propagandist" is not used in any derogatory sense whatever, but rather as a concise means of describing an initial reaction to Mr. McConnell's views. His right as a United States citizen to propagate his honest convictions is not questioned.

In support of his argument for the export of power, Mr. McConnell lays stress on the friendly relationship which has for so long existed between the two countries, and the similarity of their political institutions. The friendly relationship exists primarily by reason of the fact that the citizens of both countries speak the same language and derive sustenance from natural resources of enormous extent and of like variety and type. Personal contact therefore takes place with full mutual understanding, and commercial relationships are facilitated by the similarity of the commodities in which the citizens of both countries deal. Mr. McConnell's argument under this head might be established if hydro-electric power could be regarded as a trade commodity or an ordinary article of commerce, but it is not. Furthermore, there lies between the political and judicial institutions of the two countries a chasm which is not likely to be bridged. This fact holds a threat for the future if Canada, instead of selling outright the product of a vitally important natural resource, simply hires it out to the United States, and perhaps many years later attempts to reclaim it under then existing political conditions.

Mr. McConnell also makes use of the following generality: namely, that Canada possesses water power resources to the extent of 20,000,000 horsepower, and that such being the case, the population of Canada would require to be 100,000,000 before this quantity of power could be absorbed. This may be academically true. Practically, however, it has no more significance than a statement that as the Niagara Peninsula, having an area of so many square miles, can produce so many baskets of peaches per annum, therefore the whole of Canada, having an area of so many square miles, can produce proportionately so many baskets of peaches. If this argument were reduced to its logical dimensions, the amount of power commercially available to the two countries would be considerably less than half of the figures used by Mr. McConnell, and the population ratio would be reduced in at least a like proportion.

The real substance of the author's argument lies, however, in the fact that he looks upon a unit of electrical energy as a commodity to be disposed of through the ordinary process of barter and sale, like a bushel of wheat. This assumption may be admissible from his point of view, but from the Canadian viewpoint a unit of electrical energy is not a commodity in the above sense, but a means to an end, an agency for the creation of population, which is

now Canada's pre-eminent need, and will continue to be for many years to come. In other words, the United States is interested in Canadian water-power primarily as an agency for sustaining population, while Canada needs it to create population. This distinction is fundamentally important.

Also, while it may be assumed that a contract can be framed which will give Canada the legal *right* to reclaim exported power, it does not by any means follow that, as between two nations having dissimilar political institutions and methods of judicial procedure, this right could be exercised without friction at any time in the future. And even though this contingency be ignored, it is obvious that the reclaimed power cannot carry back with it to Canada the industrial fabric and the background of home and community life which its use created in the United States.

The above argument does not preclude the consideration of the reciprocal interchange of primary power for purely emergency purposes, or the export of off-peak or secondary power under contracts revocable at pleasure. Also, where a joint development takes place on international waters, the export of surplus primary power might be considered permissible as long as the receiving country had sufficient undeveloped capacity at the site to make good the withdrawal of the exported power by the comparatively simple process of installing the necessary compensating capacity on its own side of the boundary.

The conclusion is, therefore, that while Mr. McConnell's proposition may be in part demonstrable, it cannot be accepted in the general sense in which he has annunciated it. The exceptions above cited are, for instance, very different in principle from the proposal to export power from Carillon. In this case it is proposed to develop a strategically important water-power, wholly in Canadian territory, and transmit the bulk of its primary product through Canada into the northeastern United States. Under such cirsumstances Canada would be sacrificing the substance for the shadow. She would alienate the benefits which would result from the functioning of great economic force within her own boundaries, and realize only the paltry profit arising from temporary construction activity, and an immaterial, though permanent, increase in taxable values. If such a project were financed in the United States, Canada might now even participate in the direct profit arising out of the sale of the power.

The situation would not be so serious if export power could be developed from the more remote sources in Quebec, Ontario and Labrador. Unfortunately, however, the only sources of power capable of being commercially exploited for export purposes are those upon which Canada must always depend as a primary agency through which her population may be multiplied and sustained.

Discussion

By F. A. Gaby, Chief Engineer, H.E.P.C. of Ont.

MR. CHAIRMAN, ladies and gentlemen, the discussion that has taken place on this paper by the previous speakers covers, to a large extent, the remarks that I had intended to make, and especially that of Mr. Julian C. Smith. I will, therefore, confine my remarks entirely to the situation in Ontario, and as it applies to the Hydro-Electric Power Commission in the Province of Ontario.

Mr. McConnell's discussion of some of the economic aspects of hydro-electric development in Canada is an interesting presentation and shows that this author has devoted considerable time in research of the data available. A great deal of his paper is based on theoretical considerations and not on practical operations, or that which is practically available to the commercial districts in which it may be used. He has failed to take into account the essential factors in analyzing conditions, in coming to the conclusions which he has as to the position in Canada.

It is not my intention to enter into any detailed discussion of Mr. McConnell's presentation, but being familiar with the hydro-electric conditions of the Province of Ontario, it is desirable that some of Mr. McConnell's discussions should be corrected.

I shall not deal with the statistical information regarding hydro-electric power; this relates to the Dominion as a whole. I shall, however, draw attention to the statements made by that well known engineer, Mr. Henry Holgate. Mr. Holgate states that of the 18,150,000 horsepower available in Canada, at least 11,450,000 is in the country where water power is of no value. In Quebec and Ontario, we have 3,569,000 horsepower, or fifty-three per cent. of the available horsepower.

With regard to Ontario, I may say that Mr. Holgate figures that fifty per cent is developed, while Mr. McConnell's estimate of fifteen per cent. is so far from the actual presentation of the facts as to perhaps throw very serious doubt on the statistical value of his paper. The resources of eighteen million to forty-two millions of installed capacity which is deemed to be available as premises upon which the conclusions are based by Mr. McConnell, for practical consideration of the development is entirely erroneous.

Take the situation so far as the St. Lawrence is concerned for a moment, and note the conditions of such a comparison in the international section only. We have an estimate of the possible development of power somewhere in the neighborhood of two million horsepower. If we applied the same considerations as Mr. McConnell has done,—taking the quantity of power possible of development for fifty per cent. of the time, and then increasing it by thirty per cent. to obtain the installed capacities,—we would have some-

where in the neighborhood of four and one-half millions to five million of horsepower installed, which would mean that in order to obtain this quantity of power it would be necessary to regulate the flow of the St. Lawrence River accordingly, namely, approximately one hundred percent., whereas the natural regulation is only twenty per cent, and it is proposed to regulate the flow much more closely when the necessary power developments are constructed.

In Ontario, with the development as at present permitted by the International Boundary Waters Treaty, there is commercially available within the economic transmission distance of the commercial centers only two and one-half million horsepower. The total installed capacity, so far as both private and public ownership is concerned, is approximately one and one-half million horsepower, or over fifty percent. of the available water powers are at present developed.

At the present moment the loads in Ontario are increasing from seventy-five to one hundred and twenty-five thousand horsepower per annum, notwithstanding the industrial depression that we have experienced in the last three or four years.

From a consideration of this data, it is estimated that within a period of from fifteen to twenty years all the power possible of economic development will be necessary to meet the power demands in the Province of Ontario. Within that period it is hardly feasible, with all the conditions that have to be met with, to develop these water powers, and therefore the market will be available when the power is ready for use.

Mr. McConnell says, in the opinion of the writer there is no threat of shortage of power for Ontario and Quebec likely to be aggravated by export to the United States before the end of the present century.

With respect to this I shall only state that Mr. McConnell is quite under a misapprehension and his representations are incorrect. He sets his opinion against the considered opinion of the late Sir Adam Beck, against those of other Canadian statesmen, and also against the advice and representations of the leading Canadian engineers who have expressed themselves with respect to the subject of supply and demand of electrical energy in Canada.

I am, however, basing my comments on conditions as I know them to be in the Province of Ontario, and it is with respect to Mr. McConnell's reference to the Province of Ontario that I must emphatically differ from him.

Moreover, the most inexplicable feature of Mr. McConnell's statement of "opinion" is that he has been at pains to cite figures indicating the probable exhaustion of Canadian and Ontario water powers—including incidentally those which are not now capable of economic development, in various periods of from twenty-five years up. In opposition to these estimates he advances merely a calculation based upon assumptions such as, that the per capita installation of water power will remain constant at the present figure, entirely ignoring the fact that the per capita consumption in Canada

has recently been increasing at the rate of about twenty-five per cent. in two years. Nevertheless, without any supporting data, he is content to asset his "opinion" that it will be seventy-five years before a shortage of water power will occur, even though, as has already been pointed out by previous speakers, Mr. Gibson and Mr. Julian C. Smith the horsepower of population is a meaningless figure and is of no value unless the conditions under which it has been applied have been thoroughly analyzed.

Mr. McConnell says that "both nations are justified in retaining perpetual control of their natural resources and in manipulating them in the interest of their own nationals so long as such manipulation does not partake of the character of reprisals or restraints intended to set up a position of unnatural advantage."

Mr. McConnell knows as well as anyone else that in international relationships the view entertained by one nation in respect to what may be an "unnatural advantage" is often not the view entertained by some other nation in respect to the same entity.

Mr. McConnell further states in his paper that "no nation can be justly criticized for a desire to manufacture its own raw products into finished goods."

The Province of Ontario, for example, does not desire to send out of the country raw electrical energy, but desires to have its raw materials with the aid of its electric power, leave the country as finished goods.

In view of the impending immediate shortage in the supply of power, the Hydro-Electric Power Commission of Ontario finds it necessary to consider seriously the installation of a steam plant to supplement its hydro-electric sources of energy.

In conclusion, I would like to quote two other comments of Mr. McConnell, in which he refers to the exported power reverting to the owner. He states:—

> "Under what conception of international rights can such a claim be made? Under what misinterpretation of contractual obligations can the United States or any country object to the plain terms of a plain contract providing for use at a price for a designated term with reversion to the owner, at his option, at the end of the term? To reach such a conclusion is a new interpretation of belligerent nationalism quite out of harmony with the practice of the last 110 years."
>
> "As previously pointed out, neither Canada nor the United States are serious competitors for world business other than in foodstuffs and other basic products which give them a position by virtue of the possession of the commodities."

With respect to these comments, I share Mr. McConnell's desire that there must be no change in the amicable relationships that have existed between Canada and the United States for more than a quarter of a century. One of the best ways of preventing matters of contention from arising is not to

embark upon policies involving contractual obligations that cannot readily and with satisfaction to all parties concerned, be enforced. It is a difficult matter, as was found during the period of the Great War, as well as on other occasions, to withdraw the supply of electrical energy, once industries and communities have become dependent upon a particular service. Without further comment, I shall leave for Mr. McConnell's consideration the emphatic declaration made by the Public Service Commission of the Second District of the State of New York respecting the proposal to retain—as had previously been arranged—for use in Ontario electrical energy that was being exported to the United States under revocable contracts. With respect to this proposal and the means of continuing great industries in the United States which have grown up in reliance upon the use of electric power imported from Canada, the Commissioners refer to their opinion of the *fixity* of circumstances and state that:

> "In deciding these cases the Commission must assume that relations between Canada and the United States affecting the means of continuing great industries. . . have become fixed and subject only to such changes as will protect the great commercial and industrial interests and rights now served by electric power brought from Canada."

In concluding these remarks I can say that I have listened with a great deal of interest to the discussion of Mr. Julian C. Smith on this paper, and in the main I concur in the statements that he has made

The Measurement of Our Water Powers

By J. J. Trail, Engineer of Tests, Hydraulic Dept. H.E.P.C. of Ont.

(As published in the University of Toronto Monthly and revised by the Author.)

SOME years ago the paucity of information respecting water powers in British Columbia was well expressed in a statement appearing in the Year Book, for 1911, in these words: "Speaking generally, there is no subject of economic interest in connection with the exploitation of the provincial resources concerning which there is less known than the extent to which water powers may be ren-

dered available." With some qualification this statement might at that time have been applied to any of the other provinces.

The problem was, and still is, one of immense economic importance. It has been studied by various Dominion and Provincial departments. The preliminary investigations and reports in Canada were based on very incomplete information, but have had immense value in the basis they have provided for the inventory of water power resources that is in progress at the present time. By the term "inventory of water power resources" is meant a tabulation, site by site, or river by river, of the potential power in each case, based upon observations of the amount of water flowing in the stream, and measurement of the fall through which this water supply may be made effective in the production of power.

The number of horse powers that may be developed at a site is roughly one-tenth of the product of the head of water and the number of cubic feet per second that may be used. To arrive at an estimate of our resources it is then necessary to have a knowledge of these two factors. Many preliminary figures for large tracts of country have been reached by a consideration of the topography and rainfall of the country; and in fact our knowledge of the water power resources of large districts in South Africa, America and Asia is based entirely on these. Even such insufficient information as is available shows that Africa possesses nearly half the potential water powers of the whole world. This is based on a very general survey of the continent, district by district, and not upon a consideration of the power available at special sites. On the other hand, the inventory of water power resources in Canada in progress considers individual sites and known characteristics of the rivers upon which they are located.

The factor of one-tenth mentioned above by which the product of head and flow must be multiplied to give h.p. capacity at a site assumes a very high efficiency of machinery, setting and operation. It is realized only at an efficiency of 88 per cent. This is reached for example at the Queenston plant as an average for the day with a slightly higher efficiency at certain loads, but efficiencies as low as seventy per cent. are common, even in modern well operated plants.

It is obvious that the power that may be developed is a direct function of the head. For example, for a fixed quantity of water ten times as much power may be developed from the three hundred feet of fall on the Niagara river as from the thirty feet of fall at Cedars on the St. Lawrence.

Three or four considerations that affect the potential power of a water power site are worth noting. The flow characteristics of the river, the topography as it may permit storage of water, winter conditions and the nature of the market for the power. These all deal with the second of the two factors mentioned above. The first, viz., the head, has already been considered.

The magnitude of the variation of flow of the great majority of rivers from season to season and from year to year is perhaps not fully appreciated, and the significance of this variation as it affects our water power resources is certainly appreciated to a lesser degree.

There are in Canada such extremes as are illustrated by the St. Lawrence river on the one hand and the Grand river on the other. For the former at the outlet of Lake Ontario the minimum flow is over half the maximum, and this not for any one year but for half a century. The Grand river is frequently a mighty torrent at its flood with a flow equal to a fourth of Niagara but by late summer it shrinks until its channel carries only the hundredht part of its springtime flow. Between these extremes are to be found most of our Canadian rivers. None are more uniform in flow than the St. Lawrence, but some are even less uniform than the Grand.

The significance of these facts, in considering potentiality of a stream for water power development, is that for such rivers as the Grand there are many weeks at a time when a comparatively small amount of power may be developed.

Limitations set by prolonged low flow conditions each year and extreme low annual flows that occur from time to time are frequently overlooked by those promoting development.

In many instances storage resrevoirs may improve the low water flow to such an extent as to make valuable streams that would be otherwise quite unattractive. Enormous storage works have been constructed by the Province of Quebec on some of its power producing rivers, increasing the low water flow and therefore the amount of power that may be developed. The Beaver river, in Grey County, Ontario, has sufficient storage capacity to equalize its flow completely throughout the year. The uniformity of flow of the Niagara and St. Lawrence rivers, which are without spring floods or low water in the ordinary sense of the terms, is due, of course, to the natural storage provided by the Great Lakes. Artificial storage, when topography permits, may increase the available power of a river several times.

Our northern winters create hazards for many of our Canadian power plants that may curtail the output

Grand River at Brantford during a Flood Period

of power very considerably. The enormous flow of ice in such rivers as the St. Lawrence, Niagara and Winnipeg at times reduce both head and flow of water to an alarming extent. Ice jams forming on the lower Niagara river have caused the water level in the gorge to rise forty feet or more, reducing the operating head on the power plants considerably. It is questionable if there is any possibility of evaluating beforehand the effect of this factor in the power capacity of a site. Even after development the power reductions due to winter conditions are usually so irregular as to cause any average figure to be meaningless.

Throughout each day there is a continual variation in the demand for power from a generating station, the demand reaching its maximum at some time during the working day and falling to a minimum during the early morning hours. The average load is usually sixty to eighty per cent. of the maximum. It thus becomes reasonable to instal equipment in a power house in excess of that which is warranted by the available supply of water.

This assumes, of course, that the part of the average flow for a day not required to develop power at night may be held in reserve for use during the hours when a greater demand for power must be met.

It is interesting to consider the amount of power that is available in Canada, and its distribution throughout the country. The table below shows the estimated amounts of power available in the various provinces, and also the amounts that have been developed. Naturally

Ontario and Quebec are in advance of the other provinces in developed powers because their greater population, industrial development and pulp and paper industries provide large power markets and also because lack of fuel deposits precludes development of cheap fuel power.

Canada possesses about eight per cent. of the world's water power resources and twelve per cent. of the world's developed water power.

AVAILABLE AND DEVELOPED POWER IN CANADA

Province	Available 24-hour power at 80 p.c. Efficiency. h.p.	Turbine Installation h.p.
British Columbia	5,103,460	431,432
Alberta	1,137,505	34,107
Saskatchewan	1,087,756	
Manitoba	5,769,444	183,925
Ontario	6,808,190	1,742,482
Quebec	11,640,052	1,743,606
New Brunswick	120,807	44,656
Nova Scotia	128,264	63,957
Prince Edward Island	5,270	2,276
Yukon and Northwest Territories	275,250	13,209
	32,075,998	*4,259,650

*The total turbine installation at the end of 1925 was about 4,290,000 h.p.

Complaints

Goodwill-Building Opportunity

By James H. Collins

SOME concerns dodge the customer with a kick. It is said that the Interborough Rapid Transit Company (New York) has the most complete system of form letters on earth for answering complaints about its service. Write any sort of criticism, and the machine grinds out the appropriate letter. There's no chance for an argument—and the I.R.T. is probably the least-loved corporation in New York.

Others welcome the customer with a complaint, do everything to adjust things cheerfully, and send him away happy. "Send in the com-

plaints!" said John H. Patterson in the early days of the cash register, and repeated it thousands of times. "They are our school books, from which we learn what is needed and how to remedy the difficulty."

Others go still further, and turn the complaint into a sale. If the four steps of a sale are attracting attention, arousing interest, convincing and securing action, then the complaining customer has already taken the first two steps—his attention and interest may be unfavorable, but they are keen, and he is ready to be convinced.

I know more than one "trouble shooter" who has developed sales ability. If there is an ounce of selling instinct in his makeup, the very nature of the work stimulates it. His "prospect" is intensely interested, because some machine or service has broken down, he regards the trouble shooter as a disinterested expert, and will listen to his suggestions where a salesman would in all likelihood be suspected.

The customer with a kick is not only interested, but interesting. His state of mind makes it possible for a skilful salesman to handle him as deftly as a jiu-jutsu adept handles an attacker, using the latter's own strength to conquer him.

The complaining customer is indignant, and frequently anticipates a battle. He thinks it will be necessary to fight the thing out to get what he believes is his right. It was shrewd knowledge of such a condition that led many large corporations, particularly in the public utilities field, to give complaint work to women. When the belligerent kicker is met by a pretty, courteous young woman, his psychology is quickly changed for the better—the complaint department has more psychology than he has.

The complaining customer may be wrong; in which case, if the situation is tactfully explained, he will be even more open to selling suggestions.

In public utility complaints, for example, the customer often is wrong. His telephone service is bad because he needs more trunk lines. His gas or electric light service is bad because the piping or wiring on his premises is inadequate or obsolete. It is odd, but true, that many of the gas or electric light corporation's customers have never understood that the company's service is brought in to a point in the cellar, and that the quality of service thereafter depends upon the equipment the customer provides. The simple explanation of this yours-and-ours situation is selling millions of dollars' worth of modern equipment every year to people who, coming in with a grievance, have been shown that they themselves are to blame.

The biggest single factor in turning a complaint into goodwill and a possible sale is a pleasant reception

by a human being—somebody personifying the company.

In the course of some centralization to reduce expenses, about a dozen years ago, an Eastern public service corporation so rearranged its departments that the customer, say in Syracuse, with a complaint, had to thresh it out with somebody in Albany. In a little while, complaints became a problem. They grew in number and in bitterness, and hard feelings. Thereupon, the company put in Syracuse and all such communities a manager who could deal directly with customers, and, who was, to them, the telephone company. Under the new scheme of centralization, much of the actual management was still done from a few big centers. But in each sizable town there was a manager whom people knew, and could talk with.

The indignant customer nowadays frequently telephones his kick. The public utilities companies receive hundreds of telephone complaints daily, and by a standard system of dealing with them, turn the grievances into goodwill and sales.

"Is this the electric light company?" asks an angry voice over the telephone. "Well, say, what do you mean by sending in such a bill? It figures $4.85 this month, and I've never used more than three dollars' worth of electricity in any month before."

If the complaint work is organized like that of New York Edison Company, this outburst is received by an employee not only pleasant-spoken, but under strict orders never to attempt to retaliate in any way with abuse for abuse.

"Yes, sir. Will you kindly give me your name and address?"

This is the standard procedure, for the simple reason that if the reasons for the complaint were discussed first, the customer might hang up without giving his name and address, or the telephone connection might be accidentally cut off.

Figures show that nine complaints in every ten received by some utility corporations are due to a misunderstanding on the part of customers.

Practically all utility service is complex—imperfectly understood by the public.

A complaint about what seems an unreasonable increase in an electric light bill may be due to numerous things. Bills increase as winter comes on and the days shorten. They increase during exceptionally rainy months. Servants or employees carelessly leave lights burning unnecessarily. In one case, some years ago, where complaint was made of excessive bills in a downtown office building, after a preliminary investigation, the complaint department invited the manager of the building to drop down toward midnight while cleaning was going on, and from a vantage point across the street, showed him how scrub women kept a whole floor lighted while working in three or four offices on that floor. Usually, suspicion falls on the meter. Then it is tested. But only one meter in twenty is found fast, while nearly three in twenty are found slow-working to the customer's advantage. The employee in the complaint department is

buttressed by this information, as well as the company's chart showing the number of hours of daylight each month, and the days that were rainy and dark. Most of the advantages are with him, and he can afford to be pleasant and patient.

He can ask the customer to explain his grievance fully, and assure him that the company is as anxious as he is to go to the bottom of the matter and correct any shortcomings in service.

In fact, the complaint ought to be regarded as an opportunity to meet the customer and let him see how the company renders service and conducts its business—but I am inclined to think that the idea of a complaint to be settled is usually uppermost in the minds of those handling complaints.

It isn't generally known, but the most effective way of torturing a corporation is to make a bona fide complaint about its service. Except in cases where customers' bills are large, the expense of handling a complaint is almost invariably greater than the amount disputed—greater than the whole amount of the complaining customer's bill, and perhaps wiping out the net profit on his business for a year or more. Without machinery and system, the billing and collecting work on average public utility customers would cost more than service. The moment one of a utility company's customers requires personal attention, such as the taking up of a complaint or the answering of inquiries, extraordinary expense begins. The whole routine of charges, billing and collecting is organized to run with the fewest possible interruptions of that nature, and a complaint is a catastrophe—enough of them would put the company out of business.

It costs money to touch a complaint.

There is no operating profit to be squeezed out of it by any means.

The only possible profit lies in creating good feeling, the basis for further buying.

Therefore, the complaint is a sales approach when you get the right angle upon it.

And whether present sales or future, if you look at it in that way—what an approach!—*Printer's Ink.*

This Puzzling Power Factor

By "Stan Dard"

AS one moves about in industrial areas one cannot help being impressed with two facts. The first is that conditions in general are particularly favouring the existence of low power-factors. The industrial depression has a direct bearing upon this, because the immediate effects are power transformers on "no load" (or insignificant loads like a few lamps); machinery often running idle or with small input; and the continued use of inefficient old motors etc., which, under more promising conditions would be scrapped and replaced by up-to-date plant.

The second fact that one notes is the steady growth of interest shown in power factor. It may be that, under existing circumstances, this growing interest in the subject cannot always result in the practical outcome which one would like. Still, it is all to the good. One fears, though, that in many cases the local electrician can never hope really to get to grips with power factor—and this from sheer inability. His experience and knowledge are not "up to it". Often he is a fitter or the like who has been put in charge of the electrical apparatus. (In this connection the suggestion from H.M. Electrical Inspector of Mines anent the technical status of electrical men is not without its point: he urges that care must be exercised that such men are capable of undertaking their particular jobs.)

I suppose that one of the easiest forms of wit is ridicule of the ignoramus. And yet one can often derive a certain amount of benefit from a discussion (however ludicrous) with a man whose ideas are perhaps a bit dubious. I remember a works' electrician (he had actually had no technical right to the position, I found) who complained that his boss wanted to know what he was doing with power-factor in the works. The electrician was not aware that he had any such thing in the place, but had promised to look into the matter. One day, when I was in their sub-station, the electrician approached and made indirect inquiries anent "this here power factor that's knocking about". His own discoveries had led up to this illuminating stage: the power factor had appeared soon after the supply company had installed a sine meter, and he had also noticed that, although his load fell, the registration on the new meter *didn't*. And it was when the next account was presented to his employer that the alarming fact had emerged—although the units had decreased, the bill was nearly as heavy as of yore. Thus did a p.f. penalising clause assert its disturbing self—and the "electrician" find a new and weird effect.

On another occasion it was my duty to calculate the existing power factor in a rope works, and I was obtaining my data from a polyphase watt-hour meter. The electrician stood by, obviously interested but quite in the dark. At last his curiosity overcame his diffidence, and he asked me what I was doing. Still considering my figures, I murmured that I was "getting the power-factor from the meter". He looked inside the meter several times, and then he stared hard at my thoughtful self. While I was making my way out his intent gaze followed me, and as I closed the door he turned again to the matter and bent a puzzled look at the rotating disk. I have often wondered whether his search was ever rewarded.

During a visit to a factory, partly shut down, I was surprised to find a low load and a p.f. of about 0.2 on a particular curcuit. I sent for the electrician, and checked my connections and figures. By the time I had verified my facts the electrician arrived, and I inquired about his power factor. In this case there was this reply, accompanied by an emphatic shake of the head: "No, we

don't keep any of that here." However, I was sure that they *did*. Eventually I found that the load in question was an old 75 h.p. squirrel-cage motor driving idle shafting which was running in ball-bearings! When I told the electrician that they *did* have a power factor (and an unusual one, too) a broad grin appeared on his face, and he showed every sign of being quite proud of the fact. As he had never heard of the condition before, his original emphatic disclaimer was quite natural—but never again did I go by face values!

When, later, I visited another place I was a little more wary. The man who claimed to be in charge of the electrical gear regarded me with open suspicion, and I, for my part, had my doubts about *him*. "Have you any idea of your power-factor here?" I asked. "I'll turn it on for you," he replied, and began to edge away. "Just a moment," I said. "Do you know what I mean?" "I'll turn it on for you," he insisted. So I gave it up and let him "turn it on". He approached a Reyrolle switch and, with a great deal of *empressement*, closed it. "There you are," he said, "I've turned it on." I came to the conclusion that "it" must be the power. However, I suppose that in a way he *was* right.

Then there are those terrible people who have just a vague idea about power-factor. What desperate things they do and say! A little knowledge is indeed a dangerous thing. I was once much amused by a man who persisted in arguing about his "wattless opponent"; afterwards I thought that in a sense his malaprop term was rather fitting—we *are* "up against" the reactive element. And there was another acquaintance who reminded me of the man with the 75 h.p. squirrel-cage motor, for, in terms of the greatest satisfaction he announced that his place had plenty of *reaction component*. (But maybe he was a radio fan in his "off" hours.)

At a colliery I made inquiries as to whether the load conditions could be controlled. Yes, they could. *What sort would I like?* At first I was puzzled; and then a great light dawned on me when the electrician said that he could make the load *strong or weak* at will. The input was to a synchronous motor, and he was referring to the excitation. As I wanted a leading p.f., I asked for it to be made a little strong.

Another enterprising fellow informed me that he had already worked out his power factor. This was his method: Multiply the volts by the amps, and divide the product into the reading on the maximum-demand indicator. He was on the right track, but he did not take into consideration the facts that the supply was 3 phase and that the demand indicator had a constant; in addition his switchboard instruments had big zero errors. The staggering point which emerged was that in spite of all these "snags" his result was not far out!

At a works which had a bad character in respect of power factor the electrician decided to install an indicating power-factor meter. I can say without hesitation and with perfect truth that this step resulted

in immediate benefit—but not quite in the way you might think. The power-factor meter was, without authority, connected-in on the polyphase meter circuit, and in such a manner as to shunt its current coils. I said that the installation of the instrument was beneficial to the consumer. It was. The consumption at once dropped by several thousands of units per week!

One last incident in conclusion. A certain colliery electrician worked at a pit not far from a small waste-heat station. Now the latter was at the end of a long transmission line, and invariably it took the wattless load. Our friend had in some way found out the latter fact and had brooded over it. And when, one day, a supply company engineer visited the colliery sub-station, the electrician had completed his deductions, and he flung this fierce denunciation at the inoffensive visitor: "I've got your——company weighed up. You're sending me nothing else but wattless—that's what you're doing!"

—*The Electric Review,*

In Memoriam

(*Mr. Gordon O. Philp.*)

To guide awhile the handle of the plough,
  And work the new-turned furrow to its end;
To feel the solemn glory of a star,
  To know men's hearts and be to all a friend;
To walk awhile along the paths of Life,
  Where each day is a milestone that is past;
To lift one's head above the common strife,
  And stand with heart undaunted to the last;
To do th' appointed task with faithful heart,
  Ere Death comes by with quiet words of peace;
To bid the traveller rest a space apart—
  This is our lot and this our one surcease.
And Death shall fold us in with quiet hands—
  Return us to the clods from whence we came,
A brother to the mead, the shifting sands,
  The silent rocks and all earth's wide domain—
A fitting couch for us when Evening lies
  Across the bosom of our little Day;
To rest at peace beneath the tranquil skies,
  While Day and Night alternate hold their sway.
And in the caravanserai of the Dead,
  To bivouac a night, from cares set free,
'Till God's last morn shall break in flaming red,
  Charged with the thunders of our Destiny.

—Ada Elizabeth Fuller,
Niagara Falls, Ontario.

HYDRO NEWS ITEMS

Niagara System

The Village of Arkona recently passed the Hydro by-laws, and a 4,000 volt line will be constructed to the village in the early spring. Lighting service has been supplied to Arkona for a number of years from a small water power development on the Ausable River, but owing to the increased power requirements of the municipality, the water supply at the present development is not sufficient to meet the requirements.

* * * *

A 26,000 volt line from Simcoe to Port Dover, and an outdoor substation at Port Dover were recently put into operation. The Station consists of 1-300 kw. three phase unit.

The Port Dover load was formerly supplied over a 4,000 volt line from Simcoe, but the increasing load has made the higher voltage necessary.

* * * *

A new outdoor type substation has recently been put into operation at Port Colborne. The present equipment consists of 1—1,500 kw. three phase unit, with arrangements for similar units as the load increases.

* * * *

The distribution systems in Port Colborne and Humberstone have recently been changed from 2,200 volts to 4,000 volts. The change in voltage will defer for some time the expensive installation of heavier feeders.

* * * *

Ottawa System

Contracts have been received, sufficient for the building of an extension of approximately eight miles, to serve the Hamlet of Stittsville, Township of Goulbourn, from the present terminus of the line at Bells Corners.

We might also say that three and one-half miles of line is to be changed from single phase to three phase, to provide for the supplying of twenty horsepower load at the Village of Manotick.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in December, 1925.

Appliances

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED (Submittor), King & Simcoe Sts., Toronto.

GENERAL ELECTRIC COMPANY (Mfr.), Fort Wayne, Ind.

Transformers—Signal type, Cat. Nos. 219489, 219490-94 inclusive.

* * * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, Hotpoint Works Division, Stratford, Ont.

"Hotpoint" Electric Ranges, Model Nos. R24, R24C, R24E, R24EC, R25, R25C, R25E and R25EC.

* * * *

CORNISH & ROUNDING, 20 Ferry Street, Windsor, Ont.

Portable electrically-illuminated glass tablet for display sign.

* * * *

DELCO-LIGHT COMPANY OF CANADA, LIMITED, 245 Carlaw Avenue, Toronto.

"Delco - Light" Motor - operated Pumps & Water Systems, Models 129 to 132 incl., 134 to 137 incl., 139 to 142 incl., 104 to 116 incl., and 121.

* * * *

DUDABLE ELECTRIC APPLIANCE CO. LIMITED, 81 Jarvis St., Toronto.

"Sunbowl" Reflector type Air Heaters.

* * * *

HOLDEN-MORGAN LIMITED, 579-85 Richmond St. W., Toronto.

Electrical Equipment for Oil-Burning Furnaces.

* * * *

N. T. JENTO, 206 Burris St., Hamilton, Ont.

Single and Twin Unit Circulation Water Heaters.

* * * *

S. C. JOHNSON & SON, LIMITED, Frank St., Brantford, Ont.

Floor Polisher, "Johnson's".

* * * *

ONWARD MFG. COMPANY, LTD., Kitchener, Ont.

Electric Washing Machine.

* * * *

SMITH & STONE, LIMITED, Georgetown, Ont.

"S & S" air gap lightning arrester.

* * * *

*HEYER PRODUCTS CO., 34 Valley Road, Montclair, N. J.

Rectifiers, hot cathode, argon-gas filled.

* * * *

*JEFFERSON ELECTRIC MFG. CO., 501-511 S. Green St., Chicago, Ill.

Lighting Transformers (as listed on Underwriters' Laboratories card dated March 31, 1925).

* * * *

*PROPP CO., THE M., 524-28 Broadway, New York, N. Y.

Christmas tree lighting outfit, Cat. Nos. 8, 80, 82, 84, 85, 85F, 87, 87F, 108, 118, 118F, 808, 816, 1080, 8008, 8016.

Fittings

Smith & Stone Limited, Georgetown, Ont.

Stove Receptacle, Cat. No. 114; conduit receptacle, Cat. No. 1109.

Medium Base Receptacles, wall type, Cat. Nos. 1005, 1005A; outlet boxes, Cat. Nos. 1353, 1354.

* * * *

*Mutual Electric & Machine Co., 7610 Jos. Campau Ave., Detroit, Mich.

Cabinet & Cutout Boxes—Sheet Metal.

* * * *

Switches

Canadian General Electric Company, Limited, 224 Wallace Ave., Toronto.

Enclosed Switches—motor starting, Type C.R. 1038A1.

* * * *

The Devoe Electric Switch Company, 414 Notre Dame St. W., Montreal, P. Q.

Enclosed Switches, sheet metal cases, Cat. Nos. 4282, 4283 and 4284.

* * * *

Square D Company Canada Limited, Walkerville, Ont.

"Square D" Enclosed Switches—sheet metal cases, Cat. Nos. 46352-4 incl., 46341-4 incl.

* * * *

*Mutual Electric & Machine Co., 7610 Jos. Campau Ave., Detroit, Mich.

Panelboards, "Bulldog".

Plug Fuse Cutout Bases "Fusenter".

Double-pole, double-break Knife Switches. "Bull Dog Super Safety."

* * * *

Portable Lighting Devices

Electrolier Mfg. Co. Limited, 1025 Boyer Street, Montreal, Que.

Portable electric lamps.

* * * *

The Phoenix Art Metal Mfrs., 1102 Ossington Ave., Toronto.

Portable electric lamps. "Phoenix."

* * * *

Royal Art Glass Co., 243 Canal St., New York, N. Y.

Portable Electric Lamps. "Royal."

* * * *

Miscellaneous

W. H. Banfield & Sons, Ltd., 370-86 Pape Ave., Toronto.

Flexible Tubing Fasteners. "Banfield."

* * * *

Canadian General Electric Company, Limited, Peterborough, Ont.

Insulating Supports, No. 1740.

* * * *

*Canada Wire & Cable Co., Ltd., P. O. Box 518, Toronto.

Flexible Cord—rubber sheathed. Types S, SJ.

Marking: One red and one black thread cabled with copper strands.

* * * *

*These devices are under the Underwriters' Laboratories label or re-examination service.

THE BULLETIN

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Additional Development on the Nipigon River

POWER development, especially in large quantities, is absolutely dependent upon a suitable market, and any district possessing an abundance of natural resources, whether dormant or otherwise, offers great opportunity for fulfilling such a condition. In this respect, the Thunder Bay District is no exception, as is quite evident by the remarkable increase in the demand for power during the last few years, and the short space of time which has elapsed in absorbing the output of the Commission's development at Cameron Falls on the Nipigon River, thus affording ample justification for the foresight and enterprise responsible for such an undertaking, and at the same time completely eliminating and definitely silencing the criticism to which the Commission was subjected during the construction period and the early years of operation.

The Cameron Falls development began operation on December 20th, 1920, with two units of a total installed capacity of 25,000 h.p. and during the five year period since that date the growth of load has been such as to require the installation of four additional units. With the Fort William municipal load to be provided for in December of the present calendar year, and with existing load being served at the present time, which approximates 50,000 h.p., the Cameron Falls development, which is now completed according to original plans, will be loaded, thus necessitating additional development for future requirements.

The natural resources of this district consist of an abundance of forest and mineral products which, together with the grain trade at Port Arthur and Fort William furnish the raw material for the basic present and future industries. The grain trade is now firmly established and up to the advent of

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Nipigon power, was the principal industry of the district utilizing large blocks of power, the chief characteristic of which was low annual load factor. The Nipigon river being capable of supplying power for high load factor industries, stimulated the establishment of pulp and paper mills, the output of which began to increase rapidly after the Cameron Falls plant was placed in operation and this industry may also be considered as now firmly established at the head of the lakes. The mineral wealth of the district gives promise for great development in the future, but at the present time little or nothing is being done with respect to same.

Taking into consideration recent contracts executed between the provincial government and various pulp and paper companies at Port Arthur and Fort William, power will be required for the operation of three mills with an output of 400 tons per day each by 1932, whereas two of the other companies are required to make provision for greatly increased output in order to comply with the terms of the timber leases under which they operate.

To supply this demand it will be necessary to provide for 70,000 additional horsepower by 1931, and 1932 over and above the peak load capacity of the present Cameron Falls plant. About 60,000 h.p. of this total will be required specifically for the pulp and paper industry, over 55,000 h.p. of which has already been applied for and the remaining 10,000 h.p. is allowance for general increase in municipal load during the next five or six years.

To take care of this condition, the Commission has decided to proceed immediately with a new development on the Nipigon river at Camp Alexander, located about two miles below Cameron Falls. The generating station will probably consist of three units of 18,000 h.p. each, making a total of 54,000 h.p. with provision for a fourth unit, providing additional stream flow is obtained by the Ogoki diversion. This development should be completed and in operation in two years' time or about the summer of 1928. As the Camp Alexander plant will not be sufficient to take care of the demands in sight up to 1932 the Commission will make a special study of this problem during the next two years to determine which of several possible schemes will be adopted for the third development, although the Virgin Falls site seems to be the

most satisfactory for this purpose at the present time.

To provide for the Fort William municipal load a new 110,000 volt terminal substation will be constructed during the present year with an initial capacity of 15,000 kv-a. which will be available for supplying the demands of this city by December 1st.

To provide for additional load at Port Arthur at which location a large portion of the output of the Camp Alexander plant will find a market, additional transmission lines will be constructed as well as an extension to the present substation at Bare Point. This extension will consist of the installation of an additional two banks of 15,000 kv-a. transformers, thus increasing the present capacity of 30,000 kv-a. to a total of 60,000 kv-a.

With the completion of the Camp Alexander development the Commission will have inclusive of the Cameron Falls development a total of 129,000 h.p. installed capacity on the Nipigon river, the actual available output of which will, of course, be dependable upon the load factor of the load served and from the present indications this will amount to about 100,000 h.p.

The Interests of the Taxpayer in the Hydro

By Charles A. Magrath, Chairman, H.E.P.C. of Ont.

(Address before Ontario Municipal Electrical Association and Association of Municipal Electrical Utilities at Toronto, January 20th, 1926)

I FEEL that on occasions of this kind it is perhaps not altogether good taste to talk shop; but I have concluded to disregard that and to take the liberty of saying a few words to you on the interests of the taxpayer in the Hydro, and the relation that the taxpayer of this Province bears to Hydro.

While I have been a resident of Ontario during the past fifteen years, since returning from Western Canada, I must confess to you that I have not had a very clear idea of all the activities of this great organization, largely because I lived in that part of the Province where Hydro has not been very much in the limelight. I was aware that Hydro had been passing through troubled waters from time to time. I was aware that from time to time there was considerable criticism levelled at Hydro. I was aware that there was a certain amount of discontent amongst a certain group who were absolutely opposed to public ownership, largely to be found in the financial circles of the country. I was aware of those things, but I was not sufficiently intimate, I confess to you at once, with the various activities of this great organization.

In the meantime, sir, Hydro has

continued to develop and expand, and you have behind you today the credit of the country to a very considerable extent. Much of the opposition and criticism of Hydro seems to have disappeared, but still I see evidences of it here and there occasionally, and still coming, I think, from the ranks of those opposed to any form of public ownership. In fact, I regret to think that we have still some men in the financial life of this country who do not seem to be entirely satisfied with the situation.

If Hydro should fail,—which please understand I am not anticipating,—I fear that we have some men in the financial life of this country who would be more or less pleased that that should occur. But I want to point out, that if it did occur, the extent to which the taxpayers, including themselves, would suffer, is the reason that I am attempting to direct your attention for a few moments to the relationship which exists between Hydro and the taxpayer. It is the duty of every taxpayer in this Province, as Hydro is here, to be behind Hydro from beginning to end, because if it would mean anything it would be a serious thing for this Province; yes, and a serious thing for the rest of Canada; for we cannot live unto ourselves, either as individuals or as communities or as a Province. That which is of benefit to one Province in our country is of considerable benefit to the next Province, and a disaster to any Province of Canada means a disaster to all of Canada. We want to get away from the parochial idea, and realize that that which is of benefit to Canadians here is of benefit to Canadians elsewhere. It is that feature which has made me feel that I would like to point out to the financial leaders of this country, those men who consider they are heavily taxed, that it is essential to them to stand behind Hydro from the very beginning to the end, because anything that would affect it adversely would be a serious thing for them.

Because Hydro is publicly owned, it seems that it has got to be to a considerable extent in the limelight. We do not seem to be able to get away from a certain amount of criticism, coming largely, I think, from those who are opposed to public ownership. Recently there was a book published dealing with Hydro by a gentleman who formerly lived in this city. I am referring to Professor Mavor's book. Occasionally I am asked what reply I wish to make to the statements made by Professor Mavor in his book. Personally, I do not see much advantage in argument. I do not see that argument is necessary with a man who is thoroughly convinced that public ownership is not sound. The fact is that Hydro is alive today, and Hydro is going to continue to live. Professor Mavor has passed away, and I think the better thing to do is to carry on the work that we are engaged in and take no notice of those people who sit on the side of the road complaining of this issue.

I want to point to another instance in which we are brought into the limelight. Not many months ago a leading citizen of this Province, a man of high standing in the Prov-

ince, in addressing his own group referred to some legislation which was passed some years ago, I presume, which Sir Adam made use of for the benefit of Hydro, and the statement was made at the time without criticising the Hydro, because he expressly so stated; but it was bringing Hydro into the limelight by a prominent citizen, when that criticism was made that legislation was passed of a character which seemed to disturb those old Barons who obtained the Magna Charta, and who had turned in their coffins. I could hardly agree with that. I have a very strong belief that those old Barons did turn in their coffins, but it was some years previously; because, when we talk about legislation of a viscous character, if we so express it, I would suggest that the gentleman should go back to Gladstone's legislation which introduced the Irish Land Bill, which enabled the tenant to take his land from the land owner, and the figure paid for it was fixed by a Commission in which the landowner had no voice. I am not suggesting for an instant that that legislation was not sound; on the contrary I believe it was sound; but I have a very strong idea that those old Barons are rolling around in their coffins still, but not from legislation which was passed in this Province. I am not disposed to think, as a Canadian, that a Canadian Legislature has less idea of its responsibility than has the Legislature in any other part of the British Dominions. I have that confidence in my countrymen that they are not going to do anything that will not be done under similar conditions in any other part of the British Empire. And for my part, sir, the only complaint that I have to make is that Sir Adam did not leave a little of that legislation for me, because I have seen one or two occasions in my short experience when I would have liked to apply the screws.

Now, speaking more seriously, sir, Hydro needs, as I said a moment ago, the co-operation of every taxpayer in this Province. Its constant success is essential not only to Ontario but to Canada as a whole, because power at a moderate cost is necessary if Ontario's resources are to be developed. This Province yields millions of money not only to industries in this Province but to industries in the sister Province, and therefore they should be prepared to encourage in every way possible the development of power in which both Provinces are equally interested, I am referring to inter-provincial powers.

Now, a few words more intimately dealing with Hydro. I sincerely hope, gentlemen, that you do not think that Hydro is perfect. No individual is perfect; no business organization is perfect. While we claim that we are efficient, we can be still more efficient; and it is the duty of every man connected with Hydro, from my associates and myself down to the linemen, to work for greater efficiency. For my part, when I find any man,—and I do not expect to find that in Hydro,—who thinks that Hydro is perfect, so far as I am concerned, sir, he will get an opportunity to look for employment elsewhere. One of the difficulties which confronts Hydro is

that it is a tremendous organization. Very frequently it is competition which keeps men up on their toes. It is your duty to keep this organization up on its toes; and it is your duty to see that the Commission itself is kept in that position. It is only by accepting that doctrine and living up to that principle that we will carry this work through, and carry it forward as Sir Adam had in view.

Do not let us be satisfied with ourselves. Let us keep an open mind on all questions, and let us look for greater improvement. There are two ways to make money, and the safest way that I know of is to save money; and let that be a watchword with us. I am not suggesting for a moment that that is not the watchword, but this is my first appearance before you gentlemen, and I want you to appreciate that that is my point of view in the conduct of any business organization.

Another thing that I would like to draw your attention to is that every organization runs into lean years. They do not say very much about it in connection with privately controlled organizations, but a publicly owned organization is forced to be exposed to the public observation when it runs into a difficult position; and we will from time to time run into difficult positions. Remember, gentlemen, that there will be gentlemen on the fences around us ready to throw up their hats and say, "I told you so"; and while at the present moment I see no sign of anything of that character, it is the history of the world and it is the history of every organization as well as the history of the individual that you run into things which cause you more or less embarrassment. But do not let us worry about that, until those things come. Do not worry because a few of those who are so strongly opposed to public ownership will get on the fence and say, "I told you so"; but put your backs into your work and determine to pull us out at the shortest possible date. You will please understand that I see nothing of that character in sight. I have the fullest confidence in my associates, I have seen every desire on the part of my associate who is here and my other associate to do their very best for this great organization; and I have seen that spirit carried right down in the office with which I am connected; but I cannot help but impress upon you the thought that we must look for better results in the interests of the people of this Province.

Finally, I am told, gentlemen, that occasionally public ownership organization cannot succeed. That is a doctrine, sir, that I cannot understand. I can imagine that doctrine being preached by men who are not satisfied of their own honesty; but where men have confidence in themselves and in their own integrity, I see no reason why Hydro should fail or why any public ownership organization should fail, as long as you can keep your men up on their toes and make them realize that it is greater efficiency and still greater efficiency that we have to look for. So that I am not alarmed about the future of Hydro any more than you are, gentlemen, not the slightest.

As I was leaving the office this afternoon, a few figures were placed in my hands which will be of interest to you. I find that the operating capital of the Commission in power properties increased in 1925 from $181,900,094.97 to $190,037,950.49 or an increase for the year of $8,137,855.52. The capital expenditures of the Commission against municipalities and power properties, to the end of 1925, exceeds $260,000,000. The total revenues from power properties collected by the Commission for the year 1925 amount to about $18,000,000, as against $16,547,491 in 1924.

The total number of municipalities now being served by the Hydro Electric Power Commission, is 449 municipalities, being an increase of over 50 during the year 1925, and includes 23 cities, 85 towns, 105 villages, 74 police villages and 162 townships. Of these municipalities, 410 are under direct contract with the Commission, the remaining 39 being served as part of rural power districts.

In respect to the municipalities, the situation, as I understand it, is that it is estimated that the revenue of the municipalities for the year 1925 will reach the sum of $20,000,000, upon which there will likely be a surplus of a million dollars after providing all reserves for sinking fund, contingencies and depreciation.

Although complete information is not yet available for all municipalities, it is estimated that the total reserves of the Commission and the municipalities for the above items will reach the sum of $46,000,000. This is a remarkable showing when one realizes that the average period of operation of the municipalities connected with the general system does not exceed ten years and the annual reserves set up in the future will be greater as the municipalities all take up the sinking fund charges.

Now, in respect of the situation in the rural parts of the Province, there has been considerable activity in the extension of rural lines during the year 1925. The capital expenditure increased from $2,400,000 in 1924 to $3,304,000 in 1925, or approximately a million dollar increase. The miles of line have increased from 1,205 in 1924 to 1,569; and the total number of consumers has increased from 10,345 to 13,899, in addition to which we have 1,246 consumers with contracts signed for connection. The rural bonuses amount to $1,700,000 to date. In addition to the rural consumers in over 150 townships, there are suburban consumers to the extent of some 11,418. These facts show the great interest that the rural districts are taking in the supply of electricity for their communities.

Now I come to a matter which is of concern to us all, and that is the question of the power situation in the Province. At the last Convention of the Association of Municipal Electrical Utilities of Ontario it was reported that the load on the Niagara System would be in excess of 710,000 horse power. The actual loads existing on the Commission's System in November and December of 1925 reached a peak of 760,000 horse power, with a total on all the

seven systems operated by the Commission of over 950,000 horse power. The increases in capacity or equipment during the year were: Queenston-Chippawa development, units 8 and 9, equal to 110,000 horse power; Nipigon System, units 5 and 6 with 25,000 horse power; or a total of 135,000 horse power.

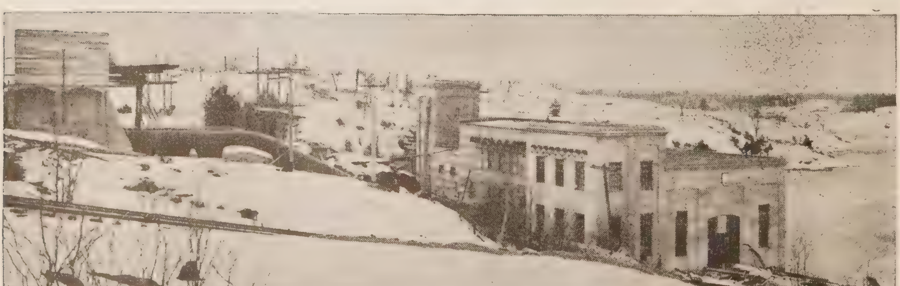
The Commission during the year 1925 received from the Ontario Government leases for the Ontario water powers on the Ottawa River at Carillon, Chats Falls, Rocher Fendeu and Des Chenes totalling, as Ontario's share, approximately 250,000 horse power.

The load on the Nipigon plant has reached 50,000 horse power. In view of the rapid expansion in the pulp industry north of Lake Superior, we must take early steps to develop additional power in that territory. Fortunately we have the power sites all available.

In respect of the Niagara System, it is well known that we will, comparatively speaking, soon need more power.

The Commission has passed through its first era in the development of power sites entirely within its own control. Now we have to look after international and interprovincial sites; and while progress may be slow for a short time, I feel that shortly the Commission will be able to make some definite statement as to future power supplies.

We always have, gentlemen, an alternative to fall back upon, the steam plant idea, which, personally I feel we should keep out of the picture for the present at least. Beyond saying to you that conferences have been had with the Quebec authorities in respect of power from the East, you can quite appreciate that it would be unwise for me to go into details publicly at this time. It is very gratifying to be able to say that the Prime Minister of Quebec has expressed himself as not only being willing but anxious to cooperate with Ontario in the power supplies of this Province."



Lightning—Modern Theories o Thunder Storms

By E. E. F. Creighton, General Electric Company, Schenectady, N.Y.

(Extracts from address before Association of Municipal Electrical Utilities at Toronto, January 20th, 1926)

IF we go back to the kindergarten, I think we will find a definition which might fit, "When she was good, she was very good, and when she was bad she was horrid"—that represents lightning storms. If they are very good, the electricity utilizes itself and, like mercy, it droppeth from heaven on the place beneath, as Shakespeare says, and no damage is done.

In California and in Chile, they have nothing but good lightning storms. Around the Gulf of Mexico, they have a hundred storm days per year. In this neighborhood, if I remember the Government chart correctly, you have between thirty and forty storm days a year.

Before I say a word about the storm, it does seem to me to be apropos to point out the situation that you have here in Canada. Here is the problem of taking more power from Niagara Falls, and here is the St. Lawrence development scheme, which we hope is just about to be brought to completion; and here is the tidal power development, at the Bay of Fundy; and the most astounding thing of all is when you talk about making a new lake up near Hudson Bay, twice as big as Lake Superior, turning rivers back into the Great Lakes and taking out some five hundred thousand horse power. Now, when we develop that power, it will have to be delivered not locally but at a great distance; and this question of lightning protection which has bothered you so much is, I think, fundamental. It has not been solved yet.

The 220,000 volt circuits in California have given us an inkling that the problem can be solved. But where they have only two storm days per year, and those two storms very mild, a storm that you would not notice at all here. You cannot say that the 220,000 volt circuits have solved the problem of lightning making a spill over in the line; and we will not know how far that immunity extends until some of those high voltage circuits are built in the lightning storm region. However, as the voltage goes up, there is a chance that we will get beyond that place where lightning can cause great difficulties.

There are other parts to the solution of the problem; we are working on them and we have hopes. By the time that the super power systems are in, these great long distance transmission lines in the north and in the east are consummated, I think we will have a solution of the problem.

The first thing in the production of a thunder cloud is the original source, the Sun. Rays of sunshine, light energy, coming to the earth through the transparent atmosphere as it goes through a glass window, without being absorbed to any great extent, strikes the surface of the earth and evaporates the moisture, throws it into molecules of water, and they get started kicking one another so hard that they explode. Those molecules are lighter than air. If you take the molecule of water out of the body of water, you have got something that is an important point, that is lighter than the atmosphere, lighter than the molecules of oxygen and nitrogen which make up the atmosphere.

The nitrogen atom weighs twenty-eight times the weight of the hydrogen atom. Water molecules are lighter than nitrogen molecules which make up the greater part of the atmosphere. The oxygen molecule is still heavier, its molecular weight is 32. So that there is a peculiar thing taking place in the atmosphere, a lighter gas below and a heavier gas above, which makes for a state of inequilibrium. The result is that the water molecules bump back and forth and they rise in the atmosphere until they get high enough to reach colder regions and become condensed and two or more combine to make larger molecules of water, and those combine with others until we have a cloud. Then, if everything is proper and reasonable, we will finally get the rain dropping back.

A thunder storm is something which feeds on itself. If it is strong it becomes stronger and then stronger. A lightning cloud is something which forms in about five minutes or it is not a lightning cloud. In other words, it dissipates itself. Some of the great scientists of Europe, C. T. R. Wilson, for example, have very carefully collected data on the rise of the potential. It goes up until it gets to a certain point, when in about five minutes a stroke of lightning takes place and it is relieved.

We want to trace up how this storm is produced, and we go back to the theories enunciated by Dr. Steinmetz. The layer of moisture that is gathered by the sunshine in the morning through a clear atmosphere increases in thickness until it becomes unstable. You can have the morning go by and no lightning formed on a humid day when apparently all the conditions are right for a storm; but there is nothing to start a column of moisture. Dr. Steinmitz used to illustrate this, and explained what would start the moisture going upwards, as for example, a little hill where the sunshine comes down on it giving a path for the atmosphere to rise. When its continuity is broken up, the storm is ready to begin.

Now, I may pass from that point to Simpson's theory. Simpson was an Englishman engaged in some Government metereological capacity in India, and he gave some of the most important theories and proved them by experimentation, in this matter of thunder storms. He produced an upward current of air moving about fifteen miles an hour, and put big water drops running down through it. He found that this wind would not allow the water

drops to fall; they could not get through the wind. Leonard is another man who worked on it before Simpson. No water drop can fall through a wind of 15 miles an hour, because the wind keeps carrying off the surface of the water. In carrying off the surface of the water electricity is liberated. Simpson has shown that the little drop blown off from the big one is always charged negatively, and the remaining part of the big drop is charged positively.

Up in the atmosphere we have a positive cloud, the wind having blown the small particles into the negative cloud above. Between these clouds there is an electrostatic field. Between the positive cloud and the earth there is another electrostatic field. C. T. R. Wilson has measured these fields, and he found that there were lines of force from the negative cloud which went up in a circle and came down miles out from the positive fields below.

The thing in which we are most interested is the intense field between the two clouds. If there is any delay in forming the lightning cloud, just a delay of a few minutes, these clouds will be drawn together; the wind cannot always blow up, and the water will get too heavy,—there will be tons of this water up in the atmosphere in the form of large drops and small drops,—and finally the weight of that will overcome the wind. If the wind drops off slightly, these two clouds will dissipate their electricity between themselves, even without a flash at all that you could see; but the usual condition is that the storm cloud is formed so fast, that the electrical force becomes so great that the atmosphere cannot withstand it, about 5,000 volts per centimeter, or 100,000 volts per foot,—then the discharge takes place, as an initial discharge between the negative and the positive clouds.

We are accustomed to thinking of a lightning discharge as taking place between the underside of a cloud and the ground, because we cannot see the other part of it. That does take place occasionally, when this positive cloud is dragged down to the earth and the negative cloud thrown too high. You could easily tell that kind of a discharge by the fact that you have two storms; you have a positive storm, and then about two hours afterwards you will have a negative storm; but when you do get that kind of a discharge, you can see both ends of it. The usual case is that of an initial discharge taking place between the two clouds. Now, there is a very important thing taking place at that time. You can have magnetism without current, as you know, in a magnet; but you cannot have current without magnetism; and magnetism is the driving power of electricity. If it were not for that magnetism all the lightning discharge would be between cloud and cloud, and we would have no appreciable trouble on the earth. That magnetism represents dynamic energy, and it cannot stay in that condition, but the discharge has to go on. The circles of magnetism have to collapse, and as they collapse they keep pushing the discharge on. The magnetism

disappears, and the discharge extends on to earth, the part that we see. There is another part that sometimes is visible; I have seen it in the southwestern part of Colorado, when I was up in the mountains above the storm clouds, a streak of lightning that shoots up into the blue without any particular place to go to, but simply disappears; that is known as rocket lightning. Sometimes the clouds are in such a position, when you are away from them, that you can see such a discharge take place. It has no particular value, but I mention it as a sort of proof of the theory which I am enunciating, that the discharge starts between clouds and discharges between clouds, and we get our discharge as an overshoot.

I want to lay the foundation for what I hope may be developed into a means for the prevention of thunder storms. If you cannot prevent it, you have to use a certain degree of high voltage on overhead wires and certain kinds of switching arrangements. So I am going into another factor which comes in the formation of a lightning storm. Sir J. J. Thompson started the matter by discovering the electron. The electrons of positive and negative electricity are very small in their world. The negative electron is very much larger than the proton or positive charge. If you have a single proton with an electron going around it at almost the speed of light, 186,000 miles a second, you have the hydrogen atom. Something very queer comes from the sun. Nobody knows what form it has, and nobody knows the medium, but they know the results, and call it a quantity of energy, just as we speak of a positive charge and a negative charge. Now, when this quantity of energy of sunshine happens to strike one of these atoms, it does a queer thing to it, it gets into its electrons, and the electron will jump from its inner orbit to another orbit; it has some eight or nine orbits. The atom is held together by the attraction between the positive and the negative charge; so that when the electron is kicked out to its outermost orbit it is looser and can be knocked off much more easily. That is one of the preparations which the sun makes for a lightning storm, and it is one of the things which we will have to know about before we can properly predict a storm.

Now, I am going back over this hastily. We have the sun throwing its energy down; it is mechanically evaporating water and making moisture; it is treating each molecule and atom to quantities of energy and kicking the electrons out to their outermost orbit, and preparing for a storm. Then we have some accident,—I am mentioning this to show some preparations which may be made against an electrical storm.

Some years ago I studied the newspapers and in the summertime they frequently give accounts of people killed by lightning. The first thing I noticed, with a little suspicion, was that Sunday School picnics were the first ones hit. Then a little bit later the army encampments, and I noticed that electricity was not particular as to the army; and then it got into the Boy Scouts

and the Girl Scouts. It is interesting to know that some people start the storms which kill them. It is an important thing to know how to prevent that. Starting the camp fire before lunch time to make the coffee sends up the column of moist air, and the first stroke comes back into the camp without warning. If you know there is a thunderstorm coming, you can take precautions. If there is a tree handy, simply throw any sort of electric wire, any conductor, over a high branch in the tree and bring it down to earth; you do not have to ground it if you have everybody keep away from that particular tree. If you ground it, it is a little bit safer at a distance than closer to it. If the camp has a number of trees, it is better to choose a number of those trees.

Mr. Peek has worked out recently, with his two million volt lightning discharges in his laboratory, a very definite law as to how far you can get protection from a lightning rod. There is no lightning can strike within a radius of four times the height of the rod. In other words, if you have a rod up thirty feet, you can say that no lightning can strike, except on the rod, within a radius of 120 feet. Around itself it is dangerous. If it is grounded it is pretty safe if you keep away from the ground; within that area you are pretty sure to be protected. It will protect sometimes to a radius six times the height, but he was never able to get his lightning discharge to strike within four times the radius, and very seldom within six times the radius. Therefore a very simple thing to do is to take along a small wire and throw it over trees, and ask the picnickers to keep away from those particular trees.

Increasing Sub-Station Capacity and Adding Flexibility

By W. R. Catton, Manager, Hydro-Electric System, Brantford, Ontario

(Paper read before Association of Municipal Electrical Utilities at Toronto, January 21st, 1926)

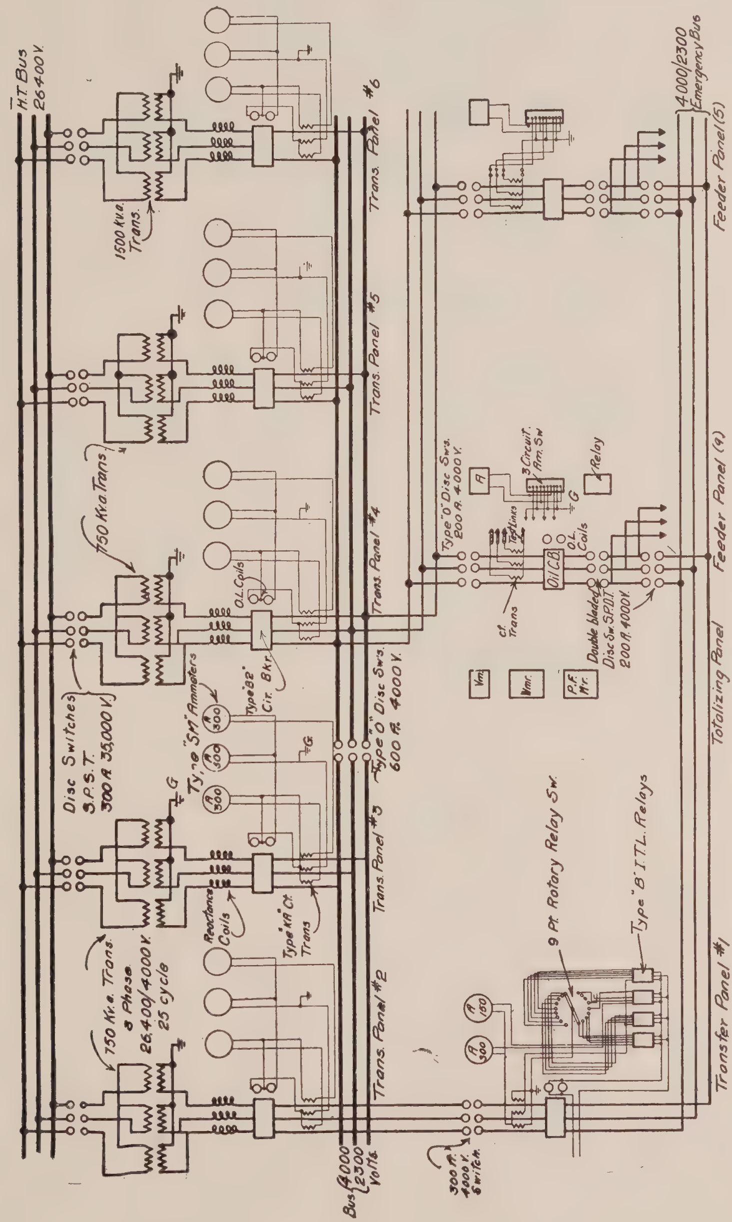
IT is the opinion of the writer that most utility managers attack the problem of increasing substation capacity with the idea of minimum capital expenditure consistent with good engineering, and as the substation is one part of our utility equipment where a great amount of capital expenditure is necessary, we sometimes hesitate or neglect to make the equipment flexible. Flexibility in your substation should be such that any apparatus can be taken out of service for repairs or inspection without interruption to the feeder, and when you have this condition other items of operating importance exist that work to a high degree of satisfaction to the entire utility.

In giving this paper it is not the writer's idea to attempt to advise regarding types of apparatus to use, but to try and help the local engineer who is contemplating changing his present equipment, by explaining how we in Brantford changed our equipment. It is needless for me to mention the fact that we were all very short-sighted when we installed our first substations, and this short-sightedness is quite excusable as you will all agree that the business taken on our local systems has been beyond the wildest dreams of our best engineers.

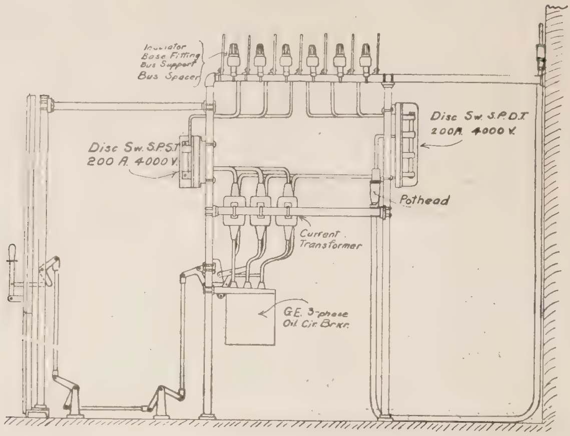
When we originally installed our substation equipment (which is a 26,000 to 4,000 volt sub) we used the standard 16 in. panels with oil switches mounted on them, directly above these oil switches were three current transformers, and above these again and running parallel to the board, the bus bars. You no doubt can visualize what a 12 panel board would look like with the oil breakers and current transformers, as well as the wiring, beautifully packed in a 16 in. space, and with this scheme how were we to repair breakers, change current transformers, etc., without killing the entire board. Then again you all know what the wreck was like after any piece of the apparatus failed; nerves, finances and service to the public suffered.

Arriving at the point where we had to add capacity to our sub, and with all the above mentioned disadvantages well known, it was a simple matter to more than double our capacity and get flexibility with comparatively sure assurance of real insulation, which we accomplished in this way. The board was moved out from the wall sufficient distance to allow us to erect a pipe frame work at the rear. On top of this pipe frame work was mounted the main bus as well as the auxiliary bus, having greater spacing than they originally had with barriers between them giving us a very high degree of safety margin. Mounted below

and on the sides of the pipe structure were disconnecting switches, below these again are the current transformers and oil breakers, and all have increased spacing, gaining for us a vastly increased safety margin from wrecks due to apparatus failure. But this is not the only feature we have gained, and I will cite some other good features, as follows:—We are able to place any feeder on the auxiliary bus at a moment's notice,



Wiring Diagram of Sub-Station Showing Arrangement of 4000/2300 Volt Feeders and Emergency Bus.



Section Through 4000/2300 Volt Feeder.

absolutely clearing the permanent feeder panel for repairs or replacements of any description. Think what this means from a service point of view. On this auxiliary bus we have a graphic meter which enables us to take a curve of any outgoing load. This feature helps us considerably in making our operating analysis, as we can separate the lighting from the power loads, and you will, I believe, agree that to be able to get curves of your various loads is a great help in the operation of our system.

If we can now have some discussion I will be glad to answer questions as far as I am able, and I would also appreciate a word from those who have installed the idea, which I believe will bring out some additional facts of value to us all.

Discussion

The President: In Kitchener we are at the present moment changing our No. 1 station to practically an exact duplicate of Mr. Catton's layout. We did not have his layout when we changed it, but we have the same layout, with the exception that we have not installed a Graphic Meter. Since reading Mr. Catton's paper, we have ordered a Graphic Meter, which will be installed.

I would like to ask a question of Mr. Catton: Do you separate your power from your lighting? Do you go further than that and separate your domestic lighting from your commercial?

Mr. Catton: Yes, Mr. President, we have separate power and lighting feeders. We have a separate commercial lighting feeder for the uptown district.

Mr. H. F. Shearer, Welland: Mr. Chairman, this paper of Mr. Catton's is extremely interesting to those of us who have had some substation trouble. The question came to my mind, and I would like to ask Mr. Catton what the capacity of the special bus oil breaker is? Is that of sufficient capacity to take care of more than one of your feeders? Can you place more than one feeder on your auxiliary bus at the same time? I notice that the diagram does not show an oil breaker between the auxiliary bus and the selector switches. It occurred to me that if that oil breaker was not of sufficient capacity to take more than one feeder, the protection is not as complete as if you had a separate switch between the bus and the auxiliary feeders.

Mr. Catton: We have an oil breaker on our auxiliary bus. We installed this oil breaker with the idea of taking care of any one feeder. If we want to examine the transformer breakers or examine or change the current transformers on the transformer bus, early Sunday morning when the load is light, we transfer the entire load to the auxiliary bus, open the disconnecting switches on the transformer bus, which lets us get at three of the transformer breakers.

The present auxiliary bus oil switch which was installed in 1921, has only 1200 kw. capacity. We have outgrown that capacity, and must instal a larger breaker this summer.

Mr. J. E. B. Phelps, Sarnia: I would like to say at the start that I think that the money spent on our substations should be subordinated to service, because the first thing we have to keep in mind is that we have to render service; and to render 24 hour service in many cases we have to spent more money than we were thinking of doing at the start.

I would like to go further into this subject than Mr. Catton has gone, and not only mention the auxiliary bus, but take the substation as a whole. I have in mind the installation of a substation, where there were electrolitic arresters, with no method of disconnecting them from the feeders or the main. The station which controlled the lines was some 40 or 50 miles away, and whenever there was trouble with lightning they had to call up this station, which was sometimes difficult to do. That station has since put in disconnects between the line and the lightning arresters, so that the latter may be repaired.

Then we must also supply ample sized copper, not only on the primary side but on the secondary. We ought to supply plenty of transformer space, to permit, for instance, changing a 1500 kw. transformer to 3000 or probably 5000 kw. capacity. We ought to supply a conduit going from the transformer to your switchboard, of sufficient size to take possibly two or three times the size of copper which you originally put in.

What I want to get at is that while Mr. Catton mentions in his paper that the loads on these plants have increased beyond the brightest expectations of any engineer,—and that is true, as we have all experienced it,—I think if we would learn

from our experience, we would find that had we spent more money than we have figured on spending on a substation, it would be money saved in the long run.

We installed an emergency bus at Sarnia, with an oil breaker of 400 ampere capacity per phase; and like Mr. Catton we have already outgrown that switch, and in another year possibly we will be putting in a larger one. The position of an emergency bus on our switchboard was a difficult matter to determine. Our Board was placed about 6 or 8 feet from the wall of the building, and it meant putting it directly above the switchboard, about 12 feet up in the air, and using switch poles to reach the switches.

In Sarnia we have our lighting load separated from our power load, which permits us to measure our lighting load on a separate meter. From its readings we have information to be used as a basis for making an analysis of the cost of our system.

Another item which was brought out by Mr. Catton is that if you have any trouble on any one feeder you can throw it over on your emergency bus. And also, if you want to measure the power load on any one feeder you can throw it over on this emergency bus and get it separate from the general load. Those are additional features which I think are important.

A Delegate: There is one point which Mr. Catton did not bring out in his paper. In that the switches, which are now placed at a distance back from the main board, are fanned out, you not only get a greater clearance on the front but also on the side. Another point is that of insulation, which has become very important, insomuch so that in a very recent installation in London the question of insulating the station for 75,000 volts, on a 13,000 volt service, was considered so serious that it was put in on that basis. That station is at present being run without an operator and is about three to five thousand kw. capacity.

A great many of you have stations which have been in operation from 8 to 12 years, and in which there are a great many oil switches which have outlived their usefulness. It is well within the memory of all of us perhaps, that capacity of an oil switch was decided on what it had to open; in other words on a 100 h.p. motor we would put perhaps a 100 kw. oil switch. Today I think there should be considered the capacity behind that oil switch. I think it would be of advantage to put in, for your incoming line, a high break-down test oil switch, retiring your present oil switches to a lower voltage on which they will work very satisfactorily.

Mr. Catton: There is just one point I would like to bring out, which I neglected mentioning. With the old layout we were confined to a 16 inch space. When we changed over to the new scheme, we made the spacing on the pipe framework 24 inches, so that we can replace any of the old oil breakers with new which we were unable to do under the old conditions.

Mr. J. J. Heeg, Guelph: We are getting more and more to the point where absolute safety is demanded

regardless of cost. And again, as to service, you know you cannot take the power off at any time. Mr. Catton's paper shows that we must make preparations to keep up the service 24 hours a day, 365 days in the year; on the other hand, we should not regard expense at the stations. One life is worth more than one station at any time. We have experienced that in quite a few of our good stations.

What we have adopted more or less in Guelph is an auxiliary station. Instead of having all your eggs in one basket, have them in two. That worked out to good advantage about two years ago. We lost two transformers in one station, and the result was that that station was out entirely; but we were able to carry the load right in December for about two weeks without a single interruption to any part of the business, which went to show that having an auxiliary station was a very valuable thing at that time and good practice. The auxiliary station, from the help protection point of view, is a good one, for the reason that you can kill the station dead and go in and do what you like there. With the auxiliary bus, there is a danger of a man getting mixed up.

Mr. E. I. Sifton, Hamilton: The only comment I have to make is in connection with the 13,000 volt primary bus. We have gone a little farther than that in Hamilton and have a 5-section ring bus, giving a possibility of operating any section, either direction, and can cut off any section.

Another feature in this connection to which I wish to call attention is that we have installed in our new substation, which is not yet operating, a live tap change bus, with an interchange from normal 2½, 5, or 7 per cent. taps, alive; in about 10 to 12 seconds operation we can change the taps on the transformer, thus doing away with the necessity for automatic voltage regulators. I hope the thing works out right. We are trying it, and will be glad to report at our summer session just what satisfaction we are having. I think it is the first installation of its kind in Canada. I know live tap changing has been applied to furnace transformers, but as yet it has not been tried out to replace voltage regulators.

Outside of those two points, I want to compliment Mr. Catton and admit that we got the idea of his 2200 volt test panels and we have doubled up on it in our new substation. We have two test panels, each one of which can be operated to test anywhere from two to four circuits at a time, and give a complete graphic record of what is on those circuits, either one circuit, two circuits, or two and two, as you might call it. With two test panels between the emergency and the regular bus, we hope to be able to get some very fair and satisfactory results from our switchboard; and I might say that it is done in the interest of economy. We have cut down on all the other 16 circuits, for which the station is laid out, to just one indicating watt-meter on each panel. Previous to that we used to have three ammeters and a watt meter, and if we wanted real information we had cut in graphic

equipment, which was seldom done.

A Delegate: I note there are no disconnecting switches between the oil switch and the bus. Instead of placing the emergency bus alongside the main bus, we try to separate them, so that in case the emergency bus requires any work done on it, it can be done in safety.

Just to create a diversion. Everybody seems to be in favour of an emergency bus. We have under consideration cutting out the emergency bus altogether and going to a unit switch for the feeder. This occupies possibly two feet in width; and the bus, current transformers, and everything, are enclosed entirely. The switches are mounted on wheels, and are connected with the bus by bayonet type contacts, the idea being that we shall have one or two spare switches in the station, on wheels, ready to run into place. This can possibly be done just as quickly as throwing over to your emergency bus. The idea is to save space in the building, which runs into considerable money.

We made out a comparative estimate on the cost, and I was quite surprised to find that the unit switch control, which I thought would have been quite expensive, was actually less than the switch with the emergency and main bus; and besides that you have the extra cost of the building. So that the total cost of the unit switch system is considerably less per feeder than the cost of the emergency bus of the present type.

We have none of these in service, nor have we committed ourselves to putting any of them in, but we have it under consideration.

Mr. Catton: With the unit switch arrangements, you would have permanent contacts, and the movable switch would wheel into place. The permanent contacts are not free from trouble.

As to the disconnecting switches between the oil breaker and the bus, we thought of that at the time. There were other things which we would have liked to have had and which we could have embodied in a new building; but we were confined to the old room, and we simply had to build our equipment according to the size of the room. We have never seen the necessity for the switches which have been spoken of.

We started with the idea of not wanting to spend much money, and used all old equipment, with the exception of the new pipe framework. What we want is safety with the best possible service at the lowest cost.

A Delegate: The unit type switch gear is not entirely new, but we have not used it, chiefly because we are afraid of the cost. I think it would be advisable for the Hydro to consider it thoroughly.

According to the diagram, if you want to work on the emergency with the other alive, you are pretty close.

One must start back further than the substation. You have to plan your whole work and see what load you are going to carry and whether it will be wise to put all your eggs into one basket, which is something Mr. Heeg does not believe in; or whether you should have more than one station. There is an economical

limit to the size of every feeder. This of course concerns the larger municipalities more particularly, because the smaller municipalities have a smaller load with smaller areas to serve.

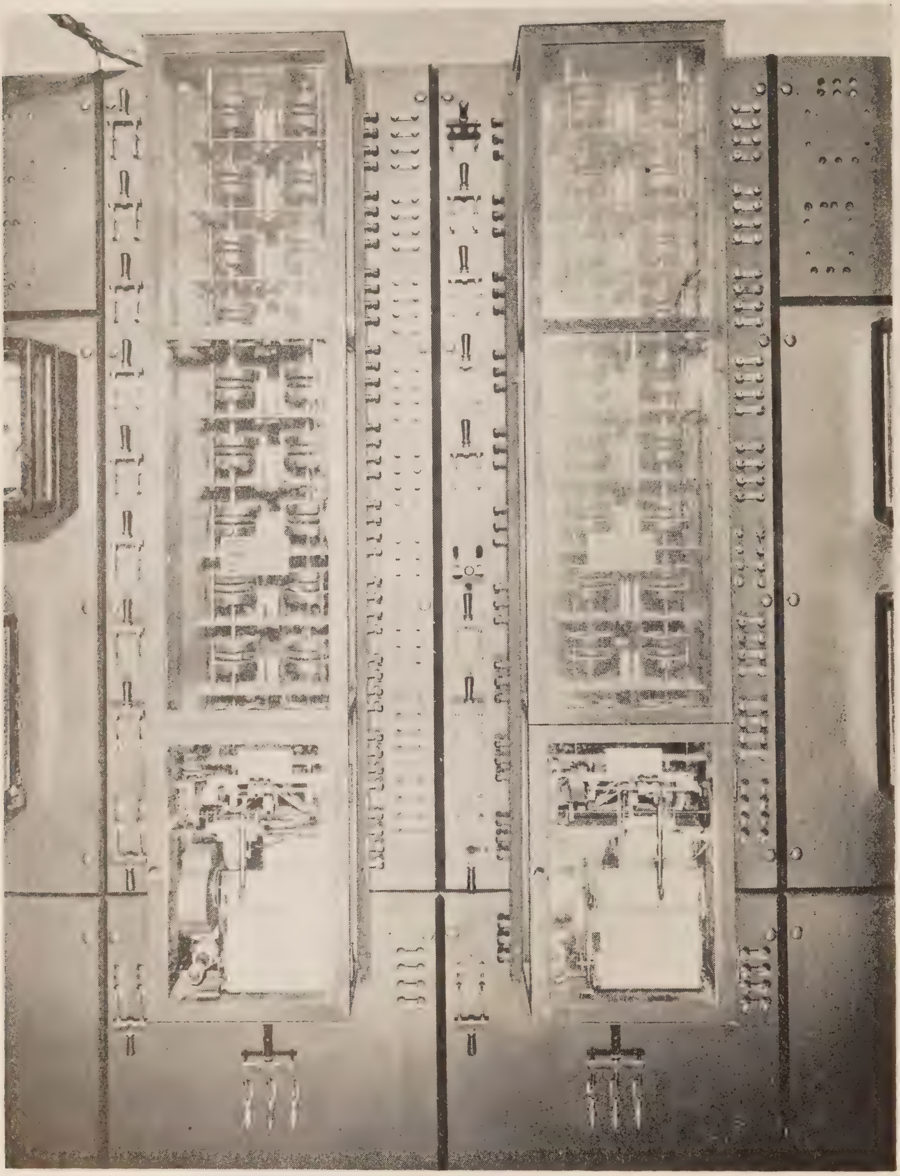
Mr. Catton: I do not get the idea of having to do so much work on your main or auxiliary buses. Put in sufficient capacity and you do not have to do any work on them. We have done no work on our bus since we installed the system.

Mr. J. H. Caster, H.E.P.C. of Ont.: We will all admit that our optimism has not been great enough and that our loads have grown, and inside of five years time after we have installed our equipment it is away too small. In designing and laying out substations, etc., we have to admit we have been too pessimistic. We must lay out our substations with the idea of having double our present load in a few years.

Mr. Wills Maclachlan: I would like to throw out a word of caution in connection with new apparatus and new designs. Remember that your men do not all know about this new apparatus or new design, while you do know. See, when new apparatus is put into operation, that your men have received complete and thorough instruction in the use and operation of it. Also see that your operating rules are changed, if necessary, to take into consideration all the troubles and variations which this new design will warrant. I have seen a good many accidents in this Province caused by lack of instruction to men, and the lack of checking up of operating rules to meet new conditions.

Mr. P. B. Yates, St. Catharines: Mr. Catton's idea of getting an auxiliary bus in the substation has been given us.

We have a bus outside and ample clearance back of the board. We run from the bus disconnecting switches to the oil switch, to disconnecting switches again and to a cable which goes out a stretch of two or three poles away from the station. Then we have another switch which runs out another feeder, and that taps through disconnecting switches at each cable terminal to every one of the different feeders which run out. If any switch or cable gets into trouble, or any current transformer or any panel, we can pull the disconnecting switches between that panel and the bus, and the disconnecting switches at the cable entrance going out, and by closing the proper disconnecting switch outside can throw any feeder onto that emergency feeder panel. That simply takes one more feeder panel and a cable possibly a distance of eight or nine poles around the substation.



Baker Totalizing Metres at Queenston Generating Station.

These two metres separately record the total power and re-action component of the output of all the generators in the Queenston Generating Station.

Ontario Municipal Electrical Association

Report of Executive Committee

To the Officers & Members of the Ontario Municipal Electric Association.

SINCE our last Annual Meeting among the many changes which have taken place, the man who was the inspiration and the leader of Hydro for so many years—Sir Adam Beck—has been taken from us and the voice that had the power to sway people into action has been stilled for ever.

The last public utterance of him who was one of our greatest Canadians was at our last Annual Meeting just a year ago and in our sorrow it is a great consolation to remember that he was spared to complete the major portion of his Hydro plans and that this enterprise as well as his work on behalf of suffering humanity has been left in capable hands and will still carry on along the lines he planned so well.

Your executive has been exceedingly gratified that in the appointment of a successor to Sir Adam, the Hon. Mr. Ferguson, Prime Minister of Ontario, in securing the service of Mr. C. A. Magrath selected a man of wide experience, outstanding ability and breadth of vision and whose appointment has been received by the Municipalities with such universal satisfaction.

In the appointment of Mr. C. A. Maguire to the vacancy on the Board of Commissioners, Hon. Mr. Ferguson again earned our gratitude in giving the Municipalities a representative on the Commission and in appointing as their representative the man who had been selected by our Association and whose appointment had been requested by us on many occasions.

We also wish to express our appreciation of the untiring efforts of the other member of the Commission, Hon. J. R. Cooke, during Sir Adam's long illness and we feel that in the Board as at present constituted we have men who are sympathetic to the Hydro cause and ready to co-operate with the Municipalities at all times and in whom we have the utmost confidence.

Early in the year the Dominion Government announced the levying of an export tax on electric power and in view of the contracts entered into by the Ontario Power Company previous to its being taken over by Hydro this would have meant a burden of at least $125,000.00 a year, for the next 25 years, on the municipalities using Hydro.

A deputation from our Association representing all parts of Ontario went to Ottawa and laid our case before the Government and this was followed up by petitions from the municipalities separately and the further presentation of our case to the various ministers and members of the House.

This necessitated a large amount of work and a number of trips but we have the satisfaction of knowing that the tax has not been imposed which

means a large saving to every municipality using Hydro power.

The abstraction by Chicago of a large amount of water from Lake Michigan which affects the boundary waters between Canada and the United States has been continued despite the strenuous protests of many of the states, and the Province of Ontario and the Dominion Government and our President, Mr. Maguire, has spent a very deal great of time in connection with this before the United States Government at Washington and at other places in the United States when meetings of protest have been held.

The Great Lakes and Harbors Association have recognized Mr. Maguire's services by electing him Vice-President of their Association, and it will be necessary to make further journeys to the U. S. Capital when the case will be heard again in March.

The services of your Executive have been called in on a great many other occasions in many parts of the Province in minor matters of various kinds connected with the Hydro System and we believe the municipalities are growing closer together and realizing the value of co-operation and united effort to a larger extent each year.

Our finances are in a fairly prosperous condition, a larger number of fees being paid this year than for some time and the grants from the Municipal Underwriters arranged during 1924 have made it easier to carry on our work.

The matter of the development of the St. Lawrence is still in abeyance and while every effort has been made by the Ontario Government, the Hydro Commission, and our Association to get the plans laid before the Government two years ago approved, we cannot at this time see any definite promise of an early solution of this difficulty.

However, most of the other progress made has been by repeated persistent effort and we are of the opinion that with the united support of all the Hydro using municipalities in Ontario we shall be ultimately successful in establishing on the St. Lawrence in Eastern Ontario a power development that will rival the Queenston-Chippawa development in Western Ontario.

Two wonderful joint Conventions have been held during the past year in which the administrative and operative ends of public service have been able to gather together, exchange views and discuss experiences of the past and plans for the future and we believe these joint meetings have been profitable to all parties attending them.

At the June Convention, a Joint Committee was appointed to consider a pension and insurance plan for Municipal Hydro employees along the same lines as in operation among employees of the Ontario Hydro system.

A considerable number of meetings were held, data secured from the principal Municipal systems and the Ontario Hydro Commission were asked to secure the necessary information and the whole proposition has been very carefully and thoroughly gone over and is being presented

to this Convention for consideration and if adopted we ask the support of all members.

The matter of Municipal Insurance which has been discussed somewhat informally at one or two previous sessions will be brought up again and all municipalities have been notified so that we may have a full and free discussion to secure all available information.

The election of officers will take place at this Convention and there will be some changes at least, as two if not three members of the Executive wish to retire and we ask the members to give some thought to the Executive for 1926 as the work is becoming heavier each year and it is necessary that we have a Board that will be ready to co-operate with the members at all times and in whom the municipalities have confidence.

Minutes of Annual Meeting

ANNUAL Meeting Ontario Municipal Electric Association, held at the King Edward Hotel, Toronto, January 20th and 21st, 1926. The greater part of this Convention was held in conjunction with the Association of Municipal Electric Utilities including Mr. Gaby's address in respect to the St. Lawrence and also the Moving Pictures of the St. Lawrence as well as Mr. Maguire's address in respect to the Chicago Drainage Canal and the report of the Committee *re* Pensions, reports of which either appeared in the Press or will be forwarded in due time.

The meeting for election of officers, presentation of reports, etc., was held on the 21st, at the same place, at 2.30 p.m. Owing to President C. A. Maguire being at a Conference with the Government and the Hydro Commission, the Chair was taken by Mr. F. Newman.

After outlining some of the work of the past year and referring particularly to the wonderful Convention of this year, Mr. Newman called for the minutes of the last Annual Meeting, which, having been previously distributed, were taken as read on motion of Commissioners, Geo. Wright and P. W. Ellis, of Toronto.

A letter was read from Windsor in reference to the establishment of three Auxiliary Power Plants throughout the Province.

The matter was finally referred to the incoming Executive to get the full facts regarding this matter from the City of Windsor and lay same before the Commission for their consideration.

A letter was read from the Municipal Underwriters Ltd., requesting that the Executive select a representative to go on the Board of Directors of the Municipal Underwriters.

Moved by Willoughby Ellis, Hamilton.

Seconded by W. K. Sanderson, St. Thomas.

THAT T. J. Hannigan be our selection for this position.

A letter was read from the Galt Commission and a resolution was introduced along the same lines asking that the Hydro-Electric Power Commission secure necessary legislation to establish an Insurance Department in which the Municipalities might place Insurance on their local Hydro plants and equipment.

On motion of Messrs. W. K. Sanderson, St. Thomas, and C. A. Tuson, Windsor. This was referred to the incoming Executive.

The Secretary read the report of the Executive Committee which was adopted on the motion of Geo. Wright, Toronto. *Seconded by* J. F. Craig, Barrie.

The Nominating Committee consisting of P. W. Ellis, Toronto; W. J. Greene, St. Thomas; Fred Newman, Picton; J. H. Shepherd, Windsor, presented the following report which was adopted on motion of Messrs. George Wright, Toronto, and H. O. Hawke, Galt.

PRESIDENT—C. A. Maguire, Toronto.

VICE-PRESIDENTS — W. Ellis, Hamilton; August Lang, Kitchener; W. K. Sanderson, St. Thomas; Fred Newman, Picton.

SECRETARY-TREASURER — T. J. Hannigan, Guelph.

EXECUTIVE—T. W. McFarland, London, Ont.; Jas. H. Shepherd, Windsor; H. P. Stephens, Niagara Falls; J. F. Craig, Barrie; Fred Harp, Brantford; R. H. Starr, Orillia; W. B. Reynolds, Brockville.

Meeting then adjourned.

Ontario Municipal Electrical Association
and
Association of Municipal Electrical Utilities

Report of Committee on Retirement and Death Benefit Plan of the O.M.E.A. and A.M.E.U.

COMMITTEE—V. S. McIntyre, Chairman; T. J. Hannigan, Secretary; P. W. Ellis, W. H. Childs, T. W. McFarland, P. B. Yates, Wills Maclachlan.

YOUR Committee was appointed by resolution at a joint session held on June 24th, 1925, at Niagara Falls, to study "A scheme of superannuation for employees of the many municipality Hydro Electric Systems, with special instructions to seek the co-operation of the Hydro-Electric Power Commission of Ontario and further that this Committee shall have power to secure the co-operation of the various Municipal Commissions."

At as early a date as possible, a meeting of the Committee was

called and it was found necessary to obtain detailed information in connection with the age, length of service and salary paid to the employees of the various Municipal Electrical Systems. A questionnaire was prepared and sent out to the Commissions and information was obtained from a considerable number of the larger Commissions, returns being made for approximately 86 per cent. of all the employees. This information was then turned over to the Hydro-Electric Power Commission with the request that an investigation be carried out to see if it were possible to include these employees in the present plan of the Hydro-Electric Power Commission and if it were not possible, to present some alternative Plan to your Committee.

The Hydro-Electric Power Commission had the information prepared for the use of an Actuary and retained Professor M. A. MacKenzie, a Fellow of the British Institute of Actuaries, to make the necessary Actuarial investigation into the situation. At the same time certain Insurance Companies were requested to submit proposals, to take care of the situation in a manner somewhat similar to that laid down in the Pension and Insurance Plan of the Hydro-Electric Power Commission of Ontario.

After very careful analyses, Professor MacKenzie reports that it would not be feasible to place employees of the Municipal Systems under the present Plan of the H. E. P. C. nor would it be advisable to set up a similar self-contained Plan to take care of only the employees of the Electrical Municipal Systems.

Various proposals were received from insurance companies and after carefully investigating the different proposals and discussing them in detail with Professor MacKenzie, your Committee favours that proposed by the Metropolitan Life Insurance Company of Ottawa, Ont. This Plan, very briefly put forward, is as follows:—

RETIREMENT ANNUITY:

For service rendered between January 1, 1910, and December 31st, 1925, service annuities being at age 65: 1 per cent. of the present annual salary multiplied by the number of years of such service will be paid for by the employer.

For service to be rendered after January 1st, 1926, service annuities for each year being at age 65, 1 per cent. of each year's salary to be paid by the employer.

Employees will contribute $2.50 (to the nearest even dollar) for each $100.00 of monthly salary (minimum deposit $2.00) for the purchase of income annuities equal to the proposal varying with present age, amount of deposit and sex.

TOTAL AND PERMANENT DISABILITY:

On total and permanent disability, benefits equal to death benefits will be paid in monthly instalments of $50.00 plus interest, such benefit to be in lieu of death benefit and in addition to any of the following annuity benefits.

All service annuities already secured will become payable at once instead of at age 65, in the event of

permanent disability after five years' service, minimum benefit 20 per cent. of current salary and maximum of $300.00 monthly. Future contributions by employees will be waived during total and permanent disability.

Death Benefits:

Benefit equal to current salary plus 2½ per cent of such salary for each year of service up to 20 years (to the nearest even $100.00 and with a minimum of $500.00) will be paid to the designated beneficiary immediately at the death of any employee. Medical examination may be required for coverage in excess of $10,000.00.

At the death of any employee there will be paid to his beneficiary a total of his deposits (on account of income annuities) less any income annuity payments that may have been received by the employee.

Withdrawal of Employee from Service:

If any employee leaves the service of an employer for any reason except for retirement, disability or death, he forfeits all service annuity and death benefits and may exercise one of the following three options as to his own deposits on account of income annuities:

A. He may continue his regular deposits direct to the Insurance Company and receive at age 65 the full amount of his income annuity

B. He may receive a paid up annuity guaranteeing him an income for life after age 65, proportionate to the deposits he has already made.

C. He may receive his money back in full without interest.

Withdrawal Credits to the Employer:

On the cancellation of service annuities, because of withdrawal from service, where withdrawal is due to any other cause than death, disability or superannuation, the employer will be credited for his deposits in full plus interest, less a small surrender charge.

Cost to the Employer:

After thorough examination of the available data, it has been found that 4.6 per cent. of the annual payroll will probably more than take care of the employers current deposits and cost.

The employer's deposits on account of past service will probably require an additional 1 per cent. to 3 per cent. of the annual payroll for the next 30 years. The amount required annually to clear up this liability on account of past services will vary of course with the nature of the personnel of each particular municipality or commission.

It is proposed that all withdrawals (which will probably result in a net annual saving ranging from .5 per cent. to 1 per cent.) will be applied to the past service fund either in reduction of current cost for the ensuing year or in the reduction of the length of time during which the cost for the past service is added to the current cost.

It is practically impossible to give an exact figure of cost as this depends upon the accrued liability of each individual municipality and the labour turnover in each municipality. However, this can be worked out with a reasonable degree of accuracy when the matter is presented to each municipality.

RECOMMENDATIONS:

Your Committee would therefore recommend that a Committee be appointed to work with the Hydro-Electric Power Commission, with a view to obtaining necessary legislation, if any is necessary, and to set up the necessary machinery so that the Plan of annuities, total disability, pension and death benefits can be made available to the various Municipal Electrical Systems and that the Committee be given power to act for the two Associations.

Signed on behalf of the Committee,

V. S. McINTYRE,
Chairman.

T. J. HANNIGAN,
Secretary.

Toronto, Ont., Jan. 19, 1926.

Association of Municipal Electrical Utilities

Opening Address

By V. S. McIntyre, Kitchener,, President

ON behalf of the Officers of our Association, I desire to welcome you to our Annual Winter Convention. At our joint luncheon today, we have gotten away to a good start. The attendance today argues well for a most successful and profitable meeting.

The growth of our organization has been remarkable. Just five years ago, the attendance at our Winter Convention was 153 and this attendance was the high mark up to that date. Today, we have one hundred per cent more, or an average increase of approximately twenty per cent per annum.

Since our last meeting at Niagara Falls, your Executive officers and Standing Committees have been busy with the affairs of the Association. Reports from these Committees will be presented to you this afternoon. The work of the Pension and Insurance Committees has been most important. Many meetings have been held and a most interesting report will be presented. I would ask you all to seriously consider this report and if it meets with your approval to endorse the recommendation of your Pension Committee.

As you will see from your programs, the Convention Committee has prepared a splendid program for you. The papers to be presented

are most appropriate in that they cover subjects in which we are vitally interested and I am sure they will be of benefit to us all. I would ask you to enter into the discussion of these papers and thus derive the fullest benefits arising through their presentation.

Tonight, at our Banquet, we are to be honored by having Mr. C. A. Magrath, Chairman of the Hydro-Electric Power Commission, address us. The industrial activity of the Province is on the increase and with such increased industrial activity, there will be an increased demand for electric power. I am sure we will all be anxious to hear Mr. Magrath tonight and receive any message he may have for us which will relieve our minds of any anxiety regarding power shortages.

Tomorrow afternoon, Mr. Maclachlan will present moving pictures showing the life of a lineman. These pictures are intensely interesting and this will be the first time they have been publicly presented. I would urge you all to remain to see them.

Certain sessions of our Convention are going to be taken charge of by the officers of our parent organization, the Ontario Municipal Electric Association. I am told they will have some very important information regarding the future development of the electrical industry of this Province to bring before us.

All of us, and especially those of us who operate Hydro shops, will be interested in the Playlett on "Selling Industrial Illumination" to be given tomorrow afternoon. I am told, that while there will be some comedy connected with this Playlett, it will also contain a lot of valuable information on industrial lighting.

I would also request you to be prompt in attending our sessions. The gentlemen who have prepared the papers to be presented have gone to considerable trouble and expense in their preparation and it is only fair and just that we attend promptly so that they will not be hampered by being limited in time.

In closing, I want to thank the officers for their support during the past year. The hearty co-operation I have received from you all has made the duties connected with this office a pleasure to perform. I thank you.

The Auditor's Report

January 18, 1926.

Mr. V. S. McIntyre,
President,
Association of Municipal
Electric Utilities of Ontario.

Dear Sir:—

We beg to advise you that we have audited the books of the Association of Municipal Electric Utilities for the year 1925, and find that the cash received and recorded by the Treasurer agrees with the Secretary's statements. The Disbursements are supported by vouchers duly au-

thorized and passed by both President and Secretary, and the cash on hand is in accord with bank book.

We respectfully submit herewith statement of Receipts, Disbursements and Assets.

Yours very truly,
(Sgd.) W. G. Pierdon,
R. C. McCollum,
Auditors.

Statement of Receipts, Disbursements, and Assets for Year Ending 31st December, 1925.

Receipts.

Cash on hand December 31st, 1924		$ 204.85
Membership fees—		
Utilities (157)	$1,148.00	
Commercial (34)	340.00	
		$1,488.00
Receipts from Convention Dinners—		
King Edward	$1,362.65	
Clifton	1,926.02	
		3,288.67
Prize money refunded		20.37
Sale of $500.00—5½% Victory Bond		522.00
Interest		47.55
		$5,571.44

Disbursements.

Convention Dinners—		
King Edward	$1,311.00	
Clifton	1,813.10	
Sundry Entertainment	494.85	
		$3,618.95
Travelling Expenses		452.18
Reporting		212.40
Printing		346.02
Badges, etc		146.30
Salaries		250.00
Postage & Telegrams		56.99
Freight		48.10
Bank Exchange		19.98
Donations		140.65
Balance		279.87
		$5,571.44

Assets

Cash in Bank	$ 279.87
Dominion of Canada 5½% 1934 bond (par value $500.00) purchase price	513.50
Interest accrued	2.29
Lantern and fixtures	243.45
	$1,039.11

Report of Regulations and Standards Committee

To the President and Members
Association of Municipal Electric Utilities.

Gentlemen:

On behalf of the Regulations & Standards Committee I beg to submit a report of their activities for the past year. We have not held any meetings but have had considerable correspondence.

The first matter which was brought to our attention was that of the 220 volt open wire elements in electric ranges. While some of the Committee felt that this was a correct move the majority felt that due to the increased cost of servicing and the unfavorable condition for grounding in a great many localities it was premature to approve of a recommendation to allow 220 volt elements in ranges.

Another matter brought to our attention was that the standard hand book for line construction was not being adopted and used by the various members of our Association. On our suggestion Mr. Lang's department circularized the members and we believe a great many more have ordered copies of the standard hand books and are going to adopt them. The Chairman of the Committee, due to his being Chairman, has also been a member of the approval Committee of the Ontario Commission and from time to time has dealt with matters brought to the attention of that Committee.

There may be many matters with which this Committee should deal and they would welcome any suggestions from the membership.

There is one matter that they would suggest next year's Committee to take up and that is the question of the standardizing of entrances; by this we mean the location of the service pipe, the location of meters, size of meter board and the wiring from entrance equipment to meters.

All of which is respectfully submitted.

Yours very truly,
(Sgd.) OSWALD H. SCOTT,
Chairman.

Report of Committee on Accident Prevention and Health Promotion

Mr. President and Gentlemen,—

Your Committee on Accident Prevention and Health Promotion beg to report as follows:—

The only meeting of this Committee was held in Toronto, March 12th, 1925. At this meeting Mr. Wills Maclachlan was appointed Secretary, and since this meeting Mr. Maclachlan has carried out through the Hydro Electric Power Commission and various other organizations the suggestions that were made and approved of by the Committee.

As I pointed out in my verbal report in June, the work of this Committee must be almost entirely on educational lines and depends on the co-operation of the membership of this Association for the success of the work. Several suggestions were made regarding the training of organizations such as the Boy Scouts, Girl Guides, etc. And, I am glad to report that owing to the co-operation of the Heads of these organizations and the officials of the different municipalities considerable interest was created in resuscitation practice and we feel that the effort put forth by your membership in giving this training will create, in time, a better understanding in the public of the correct methods of resuscitation for drowning and electric shock. Through the co-operation of Mr. Maclachlan, the instruction regarding resuscitation in the Boy Scouts' Hand-book has been brought up-to-date.

Another matter that was suggested and that has been carried out with considerable success by the Hydro Electric Power Commission was the holding of meetings by representatives of the H. E. P. C. at various points in the province, to which the men from the surrounding district were brought in and given instruction in the use of Safety First equipment, and demonstrations of resusciation given. By this means instruction was given to men from the smaller municipalities who could not be reached in any other way. We understand that meetings of this kind will be held periodically in the future.

A suggestion was made that instruction regarding prevention of accident from the use of electrical appliances be placed in the school books. At the present time an experiment is being carried on in the schools at Peterborough, where talks are being given to the scholars along these lines.

An exhibit of accident prevention devices and appliances was displayed at the June Convention. A paper by Mr. W. H. Mulligan was read on Fire Prevention when a very interesting explanation was given of the different types of extinguishers and their particular uses.

(Sgd.) H. G. Hall,
Chairman.

Minutes of the Convention

THE Convention of the Association of Municipal Electrical Utilities was held at the King Edward Hotel, Toronto, on January 20th and 21st, 1926. Prior to the opening session at 1 p.m. on January 20th, the Association met with the Ontario Municipal Electrical Association and the Electric Club of Toronto at a Convention Luncheon, which was addressed by the Hon. Chas. McCrea, Minister of Mines, Province of Ontario. At this luncheon Controller Gibbons, representing the Mayor of the City of Toronto, extended a welcome to the delegates to Toronto on the occasion of the Convention.

At 2.30 p.m. the Convention was called to order by the President, who delivered a short address outlining the activities of the Association, paying particular reference to matters to be taken up at the Convention.

The Secretary presented the report of the Auditors covering finances for the past year. He also read a letter from the Canadian General Electric Co., drawing attention to certain work on hand at their Davenport works, and inviting the delegates to visit that plant during their stay in Toronto.

Mr. O. H. Scott,presented a report on behalf of the Regulations and Standards Committee and moved that same be adopted and placed on file. On this motion being duly seconded it was carried, and so declared by the President.

Mr. H. G. Hall presented a report on behalf of the Committee on Accident Prevention and Health Promotion, and moved that same be received and filed. On Mr. Hall's motion being seconded,it was carried, and so declared by the President.

Dr. E. E. F. Creighton of the General Electric Co., Schenectady, N. Y., who was present in the absence of Mr. F. W. Peek, gave an address entitled "Lightning — Modern Theories of Thunder Storms" which was illustrated by charts and moving pictures. After the completion of his address, which was very much appreciated by all, it was moved by Mr. P. B. Yates, and seconded by Mr. J. W. Purcell that a hearty vote of thanks be extended to Dr. Creighton for his address, which was carried unanimously.

The President then announced the result of the election of officers for 1926, being as follows:

PRESIDENT—R. H. Starr, Orillia.
VICE-PRESIDENT—J. J. Heeg, Guelph.
SECRETARY—S. R. A. Clement, H. E. P. C. of Ontario, Toronto.
TREASURER—G. J. Mickler, H. E. P. C. of Ontario, Toronto.
DIRECTORS—J. G. Archibald, Woodstock,
W. R. Catton, Brantford,
O. H. Scott, Belleville.

DISTRICT DIRECTORS—
Niagara District—J. E. B. Phelps, Sarnia, Ont.
Central District—C. T. Barnes, Oshawa, Ont.
Georgina Bay District—E. J. Stapleton, Collingwood.
Eastern District—R. J. Smith, Perth.

Northern District—T. W. Brackinreid, Port Arthur.

At 6.30 p.m. the Association met for the Convention dinner which was held with the Ontario Municipal Electrical Association, and presided over by its President, Mr. C. A. Maguire. The Hon. G. Howard Ferguson, Premier of Ontario, was present and gave a short address introducing the speaker of the evening, Mr. C. A. Magrath, Chairman of the Hydro-Electric Power Commission of Ontario. This was the first appearance of the new Chairman of the Hydro-Electric Power Commission of Ontario before the Ontario Municipal Electrical Association and the Association of Municipal Electrical Utilities as a guest of the two organizations, and his reception showed a hearty spirit of co-operation towards him from all present. His address in which he outlined some plans and policies for the future was given a similar reception.

On the morning of January 21st at 9.30 o'clock, the second session of the Convention opened when Mr. W. R. Catton, Manager Hydro-Electric System, Brantford, read a paper "Increasing substation capacity and adding flexibility." Discussion following Mr. Catton's paper was by the President, Messrs. H. F. Shearer, J. E. B. Phelps, J. J. Heeg, E. I. Sifton, J. H. Caster, Wills Maclachlan, and P. B. Yates.

Following the discussion on Mr. Catton's paper the meeting turned to a joint session with the Ontario Municipal Electrical Association and Mr. C. A. Maguire took the chair. Mr. T. J. Hannigan, Secretary of the Ontario Municipal Electrical Association, presented a report from the Committee, *re* "The Pension Scheme." Mr. V. S. McIntyre moved that the report be received, which on being seconded by Mr. Hannigan was carried and was so declared by the Chairman. After considerable discussion a resolution was carried instructing the Committee to further consider the matter with the Hydro-Electric Power Commission of Ontario, and to get all necessary data, etc., and that a special meeting be called to further consider this report. Motion was also carried that the present Committee continue to function.

The Chairman, Mr. Maguire, then gave a short address outlining the progress, *re* the Chicago water diversion.

At 1 p.m. the Association met with the Ontario Municipal Electrical Utilities for Convention Luncheon, when Mr. F. A. Gaby, Chief Engineer, Hydro-Electric Power Commission of Ontario, gave an address on the proposed St. Lawrence developments. Mayor Foster of the City of Toronto being present, also gave a short address.

The third session of the Convention opened at 2.30 o'clock, when Mr. Wills Maclachlan gave the first showing of the film "Looking ahead" which was well received and given favourable comment. It is the intention that this picture will be available for the use of the Municipalities.

A playlet "Selling Industrial Illumination" was given, the various parts being taken by S. S. Bain, Solex Co., Toronto; S. G. Hibben,

Westinghouse Electric & Manufacturing Co., New York; C. H. Hopper and W. A. Orr, Canadian Westinghouse Co., Toronto.

A paper "Efficient management of public utilities" by Mr. E. V. Buchanan, Gen. Mgr. Public Utilities Commission, London, Ont. was presented. The delegates were asked to send in their discussions on this paper by mail so that the same could be printed with it.

Following this paper moving pictures of the St. Lawrence river were shown. These pictures were intended to have gone with Mr. Gaby's talk during the Convention luncheon that day but could not be successfully shown at that time.

After the showing of these pictures the meeting adjourned at 5 o'clock p.m.

The Register shows the attendance at the Convention to have been 340, being classified as follows:

Class A	102
Class B	85
Associates	38
Commercial members	92
Visitors	23

There were 347 present at the Convention dinner, while 322 attended the Convention luncheon on the first day, and 280 the Convention luncheon on the second day.

Minutes of Meeting of Executive Committee

A meeting of the Executive Committee was held at the King Edward Hotel, Toronto, on the evening of January 21st, beginning at 7 o'clock. The following members were present:

Messrs. R. H. Starr, Chairman; J. J. Heeg, G. J. Mickler, J. G. Archibald, O. H. Scott, J. E. B. Phelps, C. T. Barnes, J. R. Smith, T. W. Brackinreid and S. R. A. Clement. This meeting was called for the purpose of naming Committees for the year 1926, and to take care of any other business as brought up. The Committees agreed upon were as follows:

Papers Committee:

Messrs. W. R. Catton, Brantford, Chairman; E. V. Buchanan, London; P. B. Yates, St. Catharines; C. E. Schwenger, Toronto; S. L. B. Lines, Lincoln Meter Co., Toronto; R. T. Jeffery, H. E. P. C. of Ont., Toronto.

Convention Committee:

Messrs. J. J. Heeg, Guelph, Chairman; J. E. Teckoe, Niagara Falls; A. W. J. Stewart, Toronto; R. L. Dobbin, Peterboro; H. T. Gibbs, Can. Westinghouse Co., Toronto; A. B. Cooper, Ferranti Meter & Transformer Co., Toronto; J. H. Daly, Northern Electric Co., Hamilton; J. J. Jeffery, H. E. P. C. of Ont., Toronto.

Regulations & Standards Committee:

Messrs. J. E. B. Phelps, Sarnia, Chairman; J. R. McLinden, Owen Sound; R. J. Smith, Perth; Geo. Grosz, Waterloo; A. O. Hunt, London; W. P. Dobson, H. E. P. C. of Ont., Toronto, and A. G. Hall, Elec. Inspection Dept., Toronto.

COMMITTEE ON ACCIDENT PREVENTION & HEALTH PROMOTION:

Messrs. C. T. Barnes, Oshawa, Chairman; H. G. Hall, Ingersoll; T. W. Brackinreid, Port Arthur; E. M. Ashworth, Toronto; F. C. Adsett, Trenton; T. C. James, G. F. Drewry and Wills Maclachlan, H. E. P. C. of Ont., Toronto.

MERCHANDISING COMMITTEE:

Messrs. V. S. McIntyre, Kitchener, Chairman; O. M. Perry, Windsor; E. V. Buchanan, London; E. W. Tobin, Stratford; W. H. Childs, Hamilton; O. H. Scott, Belleville; A. B. Scott, Galt; A. W. J. Stewart, Toronto; J. J. Heeg, Guelph; J. E. B. Phelps, Sarnia; H. F. Shearer, Welland, and G. J. Mickler, H. E. P. C. of Ont., Toronto.

RATES COMMITTEE:

Messrs. G. J. Archibald, Woodstock, Chairman; P. B. Yates, St. Catharines; E. I. Sifton, Hamilton; E. M. Ashworth, Toronto; R. L. Dobbin, Peterboro; J. G. Jackson, Chatham; E. V. Buchanan, London; A. B. Scott, Galt; Geo. Grosz, Waterloo; O. M. Perry, Windsor, and all of the members of the 1926 Executive Committee.

AUDITORS:

Messrs. W. G. Pierdon and R. C. McCollum, H. E. P. C. of Ont., Toronto.

A letter from Mr. C. E. Hoshal, Manager Clifton Hotel, Niagara Falls, Ontario, was read, in which he extended an invitation to hold the Summer Convention there.

Moved by Mr. Phelps,
Seconded by Mr. Scott,

THAT the letter be referred to the Convention Committee. CARRIED.

It was decided that the next meeting of the Executive Committee would be held sometime about the end of March, when plans for the Summer Convention will be discussed. The Chairmen of the various Committees were instructed to keep this in mind to proceed with the preliminaries regarding the Summer Convention, and to be prepared to report to the next meeting of the Executive Committee complete details covering the same.

The meeting adjourned at 8 o'clock.

Further Convention Reports will appear in the March Number

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in January, 1926.

Appliances

Curtis Pneumatic Machinery Company, St. Louis, Mo.

"Curtis" Motor-operated Air Compressors.

* * * *

Domestic Electric Service, 142 Victoria St., Toronto, Ont.

Stationary Air Heater.

* * * *

Findlay Bros. Co. Limited, Carleton Place, Ont.

"Findlay" Three-burner Hotplates. Low type, Cat. No. S3; high type, Cat. No. 30S.

One-burner Hotplates, Cat. No. S11.

* * * *

The Gurney Foundry Company, Limited, 500 King St. West, Toronto, Ont.

"Gurney" Electric Range, Cabinet type, Style Nos. 4301 and 4302.

* * * *

Imperial Oil Limited (Submittor), 56 Church St., Toronto.

Gilbert & Barker Manufacturing Company (Mfr.), Springfield, Mass.

Electric-Lighted Gasolene Pumps. "Imperial Oil Limited."

* * * *

A. B. Jardine & Co., Limited, Hespeler, Ont.

Portable Pipe Threading and Cutting Machine—motor-driven.

Philadelphia Storage Battery Company, Ontario and C Sts., Philadelphia, Pa.

"Philco" Socket Power Units A, B and AB.

* * * *

Samson Cutlery Co., Rochester, N. Y.

"Samson" Curling Irons; "Duo Wave" Marcel Waver; Soldering Iron.

* * * *

Webster Electric Company, Racine, Wis.

"Webster" Ignition Coil for Oil-Burning Furnace.

* * * *

*Mackie-Lovejoy Mfg. Co., 1701-09 W. 13th St., Chicago, Ill.

"Em-el-co" Curling Irons, Cat. Nos. C200, C300, CAA, CBB.

Marking: Trade Name, Catalogue number or type letter and rating in watts and volts.

* * * *

Switches

Canadian Elevator Equipment Company, Limited, 92 Sherbourne St., Toronto.

Enclosed Switch for Elevator Door, Type C.

* * * *

*Industrial Controller Co., Milwaukee, Wis.

"I. C." Automatic Switches, Classes 7815, 7816, 8501, 8502, 8520, 8521.

Automatic Overload Relay, Class 9055, Types N1—N3 incl.

* * * *

Portable Lighting Devices

WIRT COMPANY, 5221-27 Greene St., Germantown, Philadelphia, Pa.

Portable Electric Lamps, "Wirt Co., Phila. Dim-A-Lite".

* * * *

*EASTMAN KODAK CO. (Mfr.), Rochester, N. Y.

CANADIAN KODAK CO. LIMITED (Submittor), Toronto, Ont.

Photographic Appliances (As listed on Underwriters' Laboratories card dated December 18, 1925).

"Eastman" Lamp Fittings, Eastman Safelight Lamp, Wratten Safelight Lamps, Nos. 1 and 2 Brownie Safelight Lamp.

Marking: Nameplate with rating.

"Eastman" Studio Floodlights.

Marking: Manufacturer's name and rating.

* * * *

Miscellaneous

*GARFIELD MFG. CO., Garfield, N. J.

Insulating Material (As listed on Underwriters' Laboratories card dated January 26, 1918).

* * * *

*SAYLOR ELECTRIC & MFG. CO., 1014 Lynn St., Detroit, Mich.

Flexible Tubing.

Marking: One red dotted thread woven parallel to axis of tube.

* * * *

*These devices are under Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

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The Chicago Water Diversion

By C. A. Maguire, Commissioner, H.E.P.C. of Ont. and President, Ontario Municipal Electrical Association

(Address before Ontario Municipal Electrical Association and Association of Municipal Electrical Utilities at Toronto, January 21st, 1926)

I FEEL that you would like to know something of the activities of your organization in regard to the Chicago Sanitary District Water Diversion, familiarly known as The Water Steal. Your Secretary, Mr. Hannigan and I, attended a convention in Detroit where representatives of all the Cities on the Great Lakes were present, numbering in all, about 400, and from the information gained there, I believe that we can look for some degree of success and some decision being given at a very early date.

I had the pleasure of attending a conference in Cleveland with the Attorney Generals of the seven States who are contesting the right of either Congress or Secretary of War, granting this diversion. The case will be argued before the Supreme Court in March. The Honorable Mr. Baker, former Secretary of War in the late President Wilson's administration, will represent the Great Lakes Harbors Association and from his grasp of the situation, I believe we can look with confidence as to the result. Bills will be introduced in Congress numbering three or four, requesting Congress to legalize this diversion of 10,000 second feet of water and we will have to combat this in every possible way if the decision of the Supreme Court is not rendered before then.

The Sanitary District's great cry two years ago was the fear of menacing the health of the citizens of Chicago and a plea was made from this standpoint, which, of course, was a very difficult one to combat, but we were able to produce expert

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evidence that if it was only for sanitation purposes, all they would require would be about 900 second feet. This evidence apparently made an impression on the committee that was hearing the case, for Chicago has now abandoned the question of sanitation and are demanding the water to create a water course from Chicago to the Sea, via the Mississippi. This proposal we were able to meet by evidence submitted by engineers of the Government of United States, that in their opinion only a nine-foot barge canal would be possible and the engineers, contention was, that for sanitation and navigation combined, 1,500 to 1,600 second cubic feet would be all that would be required to meet that situation. So you will see that they have been driven from one position to another.

I was very glad to note this morning a strong Editorial in the Globe to the effect, serving notice on the Dominion Government that no consideration should be given the St. Lawrence Deep Waterways project, until such times as Chicago had been stopped from using this illegal diversion of water. Chicago is using this water on the pretext of requiring it for sanitation but in the opinion of those that have been closely associated with the organization striving to preserve the Great Lakes' interest, Chicago wants this water for power purposes, where a development was built at Lockport, Illinois, thirty-two miles down the river where they generate electricity to light the parks and streets of Chicago, making a tremendous profit at the expense of both United States and Canada.

The ten thousand cubic feet per second for which they were contending, first for navigation now for a great water route to the Sea, has been met by very reliable expert evidence from the navigation standpoint. We find that it would be impossible to navigate this river where such a great flow of water existed, the current being so severe. We must always keep in mind that this question is an international one. A Treaty exists between Canada and the United States which does not permit any diversion of waters from the Great Lakes without the consent of both Countries. I might say the Government of United States took Chicago into the Courts and secured a judgment that the Sanitary District were taking water illegally and should be stopped. This was appealed by the Sanitary District and Chicago received its verdict in October last when the Supreme Court of United States gave judgment to the same affect and then they immediately followed by secur-

ing a permit from the Secretary of War until such times as Congress might pass a bill which they contend would be legal and for which the seven States that I have referred to, contested the right of Congress or the Secretary of War granting any diversion. When the decision last October was given against Chicago, the Secretary of War summoned representatives of the Great Lakes Harbors Association to attend a conference in Washington and as most of you no doubt are aware, a temporary permit allowing Chicago to use 8,500 second cubic feet until 1929, was granted on condition that Chicago puts its house in order, first to meter the City of Chicago at a cost of $12,000,000 and to construct sewage disposal works, the same as other Cities are compelled to do. Some of the citizens of Chicago are now asking in view of this tremendous expense being forced upon Chicago, is it worth while to continue the fight? Those of us that have been in close touch with the situation believe that a favorable decision will be given by the Supreme Court, and that the Statesmen of United States at Washington are not going to disregard the Treaty entered into between Canada and the United States. Your Executive believe that we should co-operate as far as possible with the American representatives seeking to preserve the great heritage of the people, namely the waterways of both Countries.

The Efficient Management of Public Utilities

By E. V. Buchanan, General Manager, Public Utilities Commission, London, Ont.

Paper read before Association of Municipal Electric Utilities of Toronto, January, 21st, 1926

TWELVE years ago I could have presented a paper with this title much more easily. I knew everything about it then. To-day it would be much easier for me to talk about the inefficient management of public utilities. At the former date I was full of the correspondence school stuff on management and the wonderful systems that could be worked out by buying magazines at $4.00 per annum each. To-day I am full of sad experiences.

The subject allotted to me is a big one and is difficult to cover in the time available at a meeting like this. Again, it is difficult to make it interesting to all as the management of a system in a city of half a million is entirely different from the management of a system in a place of half a thousand. It will, therefore, be necessary to speak in a very general way and trust that the discussion will bring forth points of interest and help to all.

The title of the paper is redundant because the purpose of management is efficiency. The manager who is unable to organize or re-organize a system without permanently increasing expenses or sacrificing the profits has not the faintest conception of the nature of his work. Such a person is generally trying to "install a system". It should be borne in mind, however, that a thorough going plan of management may, and generally does, involve an outlay of money which may not show immediate returns.

The management of public utilities involves responsibilities of an unusual character, owing in part to the fact that a public utility is a dealer in service and must be prepared at all times to supply any personal demand for such service. These exacting requirements call for foresight and skill of a high order on the part of the management; they also call for reliable equipment and for an organization in which each member is keenly alive to his responsibilities.

The manager must be actually the boss and not only the possessor of a useless title. I believe that the manager form of organization is in use by most Hydro and Public Utilities Commissions in Ontario, but in municipal affairs a very different type of control has been in common use until recent years. The duties of a Commission are legislative, advisory, and comprise the formation of broadminded policies and wise plans. The result of this is that most Commissions obtain

the services of able, clear-sighted, successful business men, who are not required to devote all their time to the details of administrative labor. The execution of the plans or laws is left to the manager who is specially trained in that field of endeavor. The spheres of action of the advisor and manager are wholly distinct and separate. The Manager should have little restriction upon his power and with only one command—produce results. He should be allowed to employ his staff and should select the members for their fitness and efficiency, and not for the payment of any political debts, and conversely should have the power to remove any employee for unfitness or lack of merit.

It is the manager's duty to see that all by-laws and rules of the commission are enforced, and should attend all meetings of the commission with the right to take part fully in the discussions.

It may be prejudice, but I have always held that an engineering training fits a man better for a manager's position than any other kind of education or training. The engineer is trained, to observe accurately, to record concisely, and finally to make his conclusions from his observations and records, and to leave out of account anything but actual matters of fact. Those who are trained to properly handle material things will surely not muddle when it comes to handling emotional and intellectual relationships.

Management deals with forces and this fact alone raises business management into the realm of those subjects worthy of being treated scientifically; "Scientific Management" would be meaningless jargon if forces were not involved. And it is well for the people who have thousands of dollars invested in plants, offices, men, etc., to realize this point at once. It will enable them to discriminate between the real efficiency engineer and the fake systematizer. The latter knows nothing of forces. He knows only forms. A manager must direct forces. He cannot be tied to the details of an office, of a department, or of an organization. His special work is cut out for him by the forces which he handles and the object which he must attain in their direction or management. The electrical engineer, the chief operator, the line superintendent, etc., have their own special provinces. Each is a specialist in the control of his own particular sphere. Yet it is sometimes expected of managers that they not only be technical experts in the various branches of the utility, but that they be expert handlers of men and judges of business methods as well. However, while a great deal of attention has been given in recent years to the subject of scientific management resulting in notable gains in efficiency which include some methods which are applicable to public utility service, yet it will be at once recognized that such service is very different from the industrial fields to which experts in this work have largely given their attention. In the utility field methods must be made subordinate to service, and service must in turn yield to safety, so that important, scientific management is by no means

the dominant or important factor that it may be in a factory.

The work of a public utility can be divided into two main classes, the commercial and the technical. The Commercial Division would include the Accounting Department, the Contract Department, the Hydro shop and the Stores Department. The Technical Division would include the Engineering Department, the Sub-stations, the Line Department, the Meter Department, the Construction Department and the Work-shops. With small commissions some of these functions may be combined, but in most cases it is best to adopt the form of organization to the character of its personnel.

The heads of these departments are responsible either directly or indirectly to the manager, but all are so inter-related that there must be the utmost co-operation between departments if mistakes and friction are to be avoided. It is usual to have frequent meetings of department heads so that there may be sympathetic understanding, and this idea may be carried still further by having occasional meetings of all employees. A free interchange of ideas between men of the same department and between different departments obtains the best judgment, opinion and practice through co-relation of these ideas and general discussion of a problem. This helps not only in solving unusual engineering and operating problems, but in ironing out difficulties among the personnel, and in strengthening the *esprit de corps* of the organization.

The Accounting Department is more than a necessary adjunct to the management, it is the vital connecting link between the manager and the owners of the plant, which in the case of a municipally owned utility are the consumers themselves. Without the proper functioning of this department both are at sea—sailing uncharted waters in a rudderless ship.

While both ends of the organization are dependent on this department for vital information and must, in theory, outline their needs, it is equally true that the department, serving two masters, must be kept independent and beyond suspicion, fearlessly determining and revealing the facts, hewing to the line letting the chips fall where they may, in order that it be effective. For this reason, the legislation makes it almost impossible to remove a municipal auditor from office except for proven misconduct, and the accounts of banks, trust companies and other concerns enjoying public trust are, by law, finally audited by independent outside auditors.

The purposes of the department are to protect the finances by safeguarding both the expenditure and revenue, and periodically showing the co-relation of each to the other. The details necessary to do this are simple or elaborate according to size and importance of the undertaking, but the function is in every case the same.

The efficient management of the Accounting Department calls for some systematized plan or scheme in such detail that the work and responsibility can be divided among the necessary force; and for an intimate knowledge of the informa-

tion required. So far as the electric accounts are concerned, this first requirement was met in the early days, by the publication, by the Hydro-Electric Power Commission, of an accounting handbook modeled after those already in use by the Interstate Commerce Commission of the United States and by the Public Utility Commissions of the more progressive States, with such modifications as were necessary to adapt the system to publicly owned utilities without permanent bonded debt or provisions for dividends. The next requirement is much more difficult as the constantly varying and never uniform personal element is encountered. Efficiency in this department requires an executive so familiar with his department as to be able to take over the work of any clerk without hesitation. Without this familiarity with details, an intelligent supervision of the amount and grade of work performed by each member of the staff is impossible, and the executive is not in a position to so change and re-arrange the work as to take advantage of the peculiar fitness each individual has for some particular phase of it. It is often quite possible to increase the general efficiency of an entire staff by a simple re-arrangement of the work without any change in the personnel.

In a well organized office each member of the staff should be entirely familiar with the work of at least two desks. This is but a common sense provision against the interruption of routine by accident, sickness, promotions or resignations, and makes it possible to utilize the spare time of each, and when necessary to obtain outside relief, to assign to the new clerk the least important work in the office.

The system of having one clerk regularly check the work of another invariably leads to slovenly work and should be discouraged. Every clerk should feel a definite and final responsibility for his or her work, and be held to it. Where the practice of cross checking prevails it is impossible to overcome a subconscious feeling that accuracy and thoroughness are not of first importance, and that any errors will be detected and corrected by the checker; and the checker passes over these errors in the hope that the first clerk did not make them. It would be foolish to contend that no final checking is necessary, but it should be made by an independent organization in no way connected with the originating office. In the case of a large railroad it was found by actual experience that a reduction of 75 per cent in the errors in the payrolls followed the abolition of cross checking by the payroll clerks, and holding each clerk responsible for the accuracy of his own work.

The object of the Accounting Department should not be a secret to even the humblest member of the staff. Each should be encouraged to take an intelligent and proprietary interest in the work and in the reports which are prepared from time to time, and the work lifted as far as possible from dreary routine.

The necessity of proper discipline goes without saying, but the day is long gone by when the best results in

this respect were dependent on what has been referred to as "the big brass hat". Intelligent co-operation calls for an independent and self-respecting staff, working on their honor, and without any feeling of inferiority. Each of them has a right to aspire to and hope for ultimate advancement to the head of the Department.

Too much stress cannot be laid on the necessity for courtesy. Members of the staff whose duties bring them in contact with the public should never lose sight of the fact that they are the servants of the public, and under obligations to answer all inquiries or complaints in a cheerful and courteous manner. Many of those who call to complain of apparently excessive bills have no real grievance, but they all think they have and that is the important thing to bear in mind; and the facts should be presented as simply and clearly as possible, without arrogance or sarcasm even when the customer is clearly in the wrong. It is usually the only point of contact between the Utility and the consumer, and consequently the logical place to develop and retain the public good-will which is such an important asset.

This courtesy should not be reserved for the public alone. It should be most assiduously practiced by every member of the staff to each other, and no rough language or objectionable practices permitted, and when additions are being made to a staff it is of first importance that no one should be selected who is not likely to contribute to the harmonious working of the office.

These remarks, while obviously intended for offices where a separate Accounting Department is maintained, apply in principle to the smaller offices as well, and even embrace a one-man organization, which is the one in which most of the delegates here are most vitally interested. It is but the application of ordinary common-sense to business. In most of the cases where we fail to measure up to a proper standard, the trouble is due to thoughtlessness, or carelessness, and the inability to see ourselves as we appear to others. Perhaps a good plan would be to observe the shortcomings of our friends and then turn the searchlight on ourselves to honestly determine if we could not find room for improvement.

Coming to the Hydro Shop let us consider the functions which Hydro Shops should perform, and the principles or general policy under which they are all supposed to operate. Briefly outlined Hydro Shops are opened—

1st. To promote the use of electric current by the sale of electrical appliances.

2nd. To uphold the standard of electrical appliances used on Hydro lines by encouraging the sale of the best.

3rd. To maintain in service all electrical appliances on consumers' premises, to insure maximum current consumption.

4th. To develop the proper kind of load, and to encourage the sale of desirable appliances and discourage the sale of others not so desirable.

5th. To educate consumers into the proper way to operate appliances, to insure complete satisfaction, and to keep electric bills within bounds.

6th. To foster the spirit of co-operation with electrical dealers in Hydro towns, to encourage them to promote the interests of Hydro, as well as their own interests.

In outlining a policy for operating Hydro Stores the pamphlet issued by the A.M.E.U. in 1924 covers, in a general way, the requirements for efficient management of such a store. If the policy thus set out were put into effect efficient management would naturally follow. The general requirements may be summed up in the following way.

In establishing a Hydro Shop one of the first necessary requirements is obviously the securing of the services of a competent manager. In the past it has been the practice of many of our Hydro Municipalities to consider a Hydro Shop a sort of undesirable adjunct to a local Hydro System and carried on in a half-hearted way.

The second important detail has to deal with the purchasing of stock in trade to carry on a merchandising business. In purchasing a stock of appliances for resale, whether they be large or small, too many lines of one type of appliance should not be handled. The reason for this recommendation is that from a point of service both in new articles being purchased and on articles sold to consumers greater satisfaction is gained all around.

Furthermore, when it comes to carrying repair parts for the many appliances in stock and sold, the greater the line of appliances the greater the quantity and value of repair parts which must be carried in stock.

In purchasing appliances for stock a manager must keep in constant touch with his stock records so that he will not over buy. Previous sales should guide him as to quantities to be purchased and for this purpose there should be weekly sales records carefully made.

In selling electrical appliances through Hydro Stores it is most important that resale prices, where these are established by the manufacturers, be maintained. There are two reasons for this, one being that stability of prices, not only in one municipality but in all municipalities, is the basis of successful selling of any line of merchandise. The other reason, and the most important one, is that from all reports gathered in the operation of Hydro Stores they need all the margin they can realize on a sale in order to make ends meet.

It goes without saying that every Hydro Shop for efficient management should have an up-to-date Accounting System, one capable of producing operating figures any day, week, or month of the year. These operating reports are useful in many ways—

1st. By helping to keep down the inventory, by showing from time to time the relation between the inventory and sale.

2nd. By keeping up resale prices to a point where the margin of profit realized on a sale is

equal at least to operating expenses.

3rd. By keeping down operating expense to within the limit of profits realized on sales, and in general keeping down the amount of capital tied up in the business.

Proper collection methods applied to consumers accounts must be adopted, and in this connection it is most important when sales are made that the customer be tied down definitely to terms of payment which will insure the ultimate payment of his account within a reasonable time, and to help the municipalities, the Hydro-Electric Power Commission Sales Department have drafted a set of rules which should be studied by all Hydro Shop Managers.

The application of these rules should be left entirely to the Manager of the Hydro Shop. He should be made responsible for their application; for carrying them out in every detail; that is to say, outside influence should not be brought to bear to prevent his performing duties as Manager which he ought to perform.

Examination of the balance sheets of a great many Hydro Shops will show that there is a tendency to tie-up an unnecessary amount of capital in accounts receivable through laxity in collection methods, and as this must ultimately result in loss through bad debts efficiency calls for the application of strict rules in this regard.

Coming to the Technical Division much of what has been already said and many of the principles enunciated regarding other departments apply again here.

In the Technical Division there is not so much contact with the public as in the Commercial except perhaps in the case of construction gangs working on the streets. The foremen of these gangs should see that they or their men do not enter into any arguments with the public, and that bad language is not used, and also that "kidding" of passersby is strictly forbidden.

One of the contacts that the Line Department has which influences public good-will to a great extent is in the matter of tree trimming. Where there is a local Parks Department the tree trimming should be entirely in the hands of that department.

The necessity of planning work is of vital importance especially in the larger municipalities. All instructions to department heads, or to employees emanating from the general office, should be in writing. Before these instructions are issued careful estimates must be made of the cost of the work, and as stated earlier, must be checked up against the expected revenue or savings so that the management will be efficient. One of the recurrent problems in utility management is that of extensions of service to reach new customers. Unless a proposed extension is clearly advisable as a matter of policy or predetermined by other considerations, it is proper to require that it be self-sustaining. In some municipalities the consumer must guarantee that the annual service charge will be at least equal to 10% of the cost of the extension. Estimates are, therefore, necessary

of earnings, expenses, interest charges, depreciation, etc. If initial or early prospective earnings are insufficient to cover expenses and charges, the extension should not ordinarily be built. There may be, of course, exceptional cases in which the service must precede the customers into a new territory.

A proper work order system is absolutely necessary so that the work in hand may be carried out to completion and the charges for material and labor allocated to the proper accounts. Unless work is performed by a system of this kind two departments interested in the same job may be charging material and labor to different accounts. The designation of charge accounts very often requires a considerable understanding of the boundaries of operation, maintenance, construction and depreciation accounts and should be in the hands of a competent person. Work orders are also useful in recording changes on the maps and tend to keep them accurate. Perhaps a more important phase of the work order system is that it provides a ready means of finding the cost of any particular work and of comparing this with the estimate.

The necessity for daily records and progress reports should be again emphasized in this Division. Of course records must not become too cumbersome, and the manager should be always on the look out for records which are of no importance, and which are simply a waste of time on the part of the employee making out such records. The records have their value in affording a basis on which to plan future work, as well as showing the necessity for replacements or unusual maintenance. Operating efficiency requires ceaseless vigilance on the part of the entire organization and is fostered by the regular collection and study of certain statistics.

Among utility operators the operating ratio is considered the most important statistical item. It is compared every month with the preceding month and with the corresponding month of the preceding year. To avoid the effect of current irregularities the twelve months ratio is also determined and compared with preceding similar period. Generally this ratio should show a slight downward tendency from year to year except as disturbed by new plant installations or abnormal prices of supplies or labor. An upward tendency in the twelve months ratio should, therefore, be analyzed and the cause definitely determined. Where the trouble is not directly remediable it may sometimes be counteracted by other economies.

There is always a tendency to curtail maintenance when other expenses are temporarily high so as to obtain a minimum variation in net earnings. This is proper and desirable to a limited extent when the regular standard of maintenance is high, but deferred maintenance almost always means higher ultimate cost.

Expenses as a whole may be worked out into units per kilowatt-hour or per horsepower. Again expenses are divisable into groups and small units for further analysis. The value of all such figures lies largely in the ability to compare them with

similar figures for other periods, or other municipalities. The former comparisons are lacking in some elements of value for unsuspected faults may run through the whole series. The value of the latter depends upon a knowledge of the essential characteristics of the municipalities compared.

The various figures discussed above may be studied directly or may be chronologically recorded in the form of curves. Graphic analysis have decided advantages particularly for a busy executive who must grasp the essential details of his business promptly. They show at a glance the relation between different things and their effects upon each other. Curves may be made to show results with any desired degree of refinement by proper selection of scales. Unnecessary refinement, such as exists from an analytical point of view in the figures in financial statements, is rejected. From a skilful manipulation of scales the continued proper relationship between two things, one of which is some function of the other, may be tested by a comparison of their curves.

Most utility data and reports are compiled monthly. Some figures fluctuate to a confusing extent due to natural causes, or to overlapping of statistical period. For example, periodical gross earnings are computed from customers meter readings taken on various dates. Unless a daily meter reading and billing system is used the readings will usually be completed some time before the end of the period. Figures of kilowatt-hours entering the system are reported for the period. Earnings per kilowatt-hour are, therefore, subject to misleading fluctuations. Such fluctuations are avoided or minimized by plotting twelve month progressive curves. Such curves show general tendencies very clearly and are of special value for birds-eye views of any phases of operation. They do not clearly show moderate current errors which require prompt attention, and they should, therefore, be supplemented by monthly curves.

Future results may often be predicted with maximum accuracy by projecting curves of past performance. The relation of current performance to predictions thus made may be clearly shown. One word of caution may be added. Statistical and graphic analysis are undoubtedly valuable. If carried to excess by enthusiasts they may, however, lead to confusion and clouding of essentials and prove a needless expense.

Among this valuable data, which should be compiled from the Technical Division in the office daily, are figures relating to station loads and power factor so that the trend of growth or decline may be closely followed. It is quite possible to make large savings on the power bill by the ability to forecast the probable peak load a day or two in advance, especially in places where there is a large amount of power whose use may be controlled by the chief operator.

If there is a system of charts covering the activities of a public utility some one of these charts is sure to behave queerly if anything goes seriously wrong with the enterprise. Conversely if all the curves look well it is reasonably certain that

the Commission's business is in a healthy condition.

Brief daily reports descriptive of the work which he has undertaken, and showing the number of men employed, should be submitted by each department head. Complete log sheets should be kept at all Sub-stations. Every meter in the Station ought to be read hourly, not because the actual figures may be necessary, but because the reading assures the Superintendent that the operator is making the complete round of the Station. This matter suggests the importance of careful inspection of all plant. Where there is machinery or apparatus which is more or less inaccessible and where the importance warrants it a watchman's clock system can be installed to advantage.

It is important that the reports, charts and records be kept up-to-date. In the case of daily charts, the records for the previous day up until the time that business ceases or until midnight should be recorded in the Manager's office before 10 o'clock the following morning. Monthly reports should be available by noon on the first of the following month.

Brief reference should be made to the commendable practice in some places of making provision for the welfare of employees. This takes various forms, including rest and recreation rooms, libraries, etc. Pensions and life insurance, etc., are important and I believe are being discussed separately at this Convention. Tact and discretion are required in formulating such plans to avoid on the one hand any suggestion of charity, and on the other any compulsory provision for the employees future, which in the final analysis comes from his pay envelope.

Fire, liability, and other forms of insurance are carried and safety first campaigns are promoted. The wisdom of such insurance is a matter for judgment in each particular case. In general, it is to be remembered that insurance merely averages risks as to time and parties and involves costs and usually profits for the insurance companies. It follows, therefore, that self insurance is cheaper in the long run and may be preferable where possible losses are not large enough to endanger financial stability. In a number of municipalities liability insurance is carried by the Commission itself, but fire insurance is usually placed in the hands of reliable companies.

The duty of a utility manager is not fulfilled when all such insurance is placed as this covers only loss of property. It cannot compensate for loss of business or the serious consequences of interruption of public service. To avoid such calamity exceptional precautions and vigilance are necessary. Protective equipment, free inspections of "house-keeping" and fire drills are precautions which the wise manager will not overlook.

In conclusion let me emphasize that efficient management depends almost wholly on the manager. He should, therefore, be a man who is straightforward, tactful, and conscientious in his duties. The manager must neither be a braggart nor a demagogue; he must have a prudent use of his words; he must never be bombastic in the execution of his duties; his remarks must be precise,

practical and to the point. He has no excuses to offer; no secret explanations to give, no one to flatter, no one to befriend. Neither must he occupy himself with politics, nor be devoted to any party or faction, and finally remember that he stands before his Commission as an executive officer stands before his board of directors.

What Price Lighting

A Playlet on Industrial Lighting

(Presented before Association of Municipal Electrical Utilities at Toronto, January, 21st, 1926)

CAST OF CHARACTERS.

A Factory Superintendent much harassed with business details of managing an industrial property.

His plant Electrician.

A Breezy Salesman of the Quick Light Company.

An Engineering Salesman of the Progressive Electric Company.

* * *

This play, while partially humorous and partially exaggerated in places, nevertheless depicts familiar incidents occurring in the office of any factory. No reflections upon the judgment or character of any of the classes of men represented are intended. To those manufacturers' representatives who have experienced the problem of interesting a possible customer, much of the dialogue will seem familiar. A great deal of the success of presentation depends on the selection of characters and where possible local hits or bits of humor will liven up the argument.

SCENES AND PROPERTIES.

The action takes place in a factory office. Typical office furniture is shown consisting of desk littered with blue-prints and lighting fixture samples, also telephone arranged with bell which can be rung by the factory superintendent from a concealed push button. Waste basket, spittoon, etc.

Back of the desk appears a blackboard marked with various production figures, etc., and a white wall space or a picture screen should be available near the desk.

For the electrician there should be provided old clothes or a suit of overalls and a few tools, coil of wire, etc.

The Quick Light salesman should be dressed in flashy fashion, brown derby, loud tie and socks, etc. He will have order book, gift cigars, etc. The lighting fixtures he demonstrates may be any monstrosity such as an old arc lamp with flat tin reflector and clear glass globe. It should be obviously a caricature of a good lighting unit.

Salesman of the Progressive Electric Company should be provided with foot-candle meter, thermometer, Brayco projector and industrial lighting film, and if possible with suit-

case type of demonstration cabinet to show glare, shadow color, etc. An electric outlet should be provided near desk for using these devices.

* * *

The scene opens in the office of the factory superintendent who is seated by his desk. The telephone rings several times.

F. Supt.: Hello, Hell — o — who 'Zis?

What, again?

(*Pause*)

How badly is he hurt?

(*Pause*)

Oh, damn it. That's the third accident you fellows have had down in that Department already this week. What's wrong down there anyway?

(*Pause*)

Yes, yes—have him fixed up, and don't forget to make up that accident report so that we can send it in to the Insurance Company. Gotta do it, even if it will probably cause us a boost in premium rates.

(*Pause*)

That's right. We sure will have to do something. We are having entirely too many accidents in this place. Why don't you hire men who aren't so damn careless anyway? Huh?

(*Pause*)

Can't see? CAN'T SEE? Why not?

(*Pause*)

Not enough light? Why, see here, man, you have more light than any other department in the whole place.

(*Pause*)

Can't see, hey? Even with those big bulbs? Well, I suppose we'll have to do something about this, anyway. (*Hanging up telephone receiver with a bang of disgust.*)

It's just one damn thing after another (*talking to himself*). Between production slump, high labor turnover and accidents, if something doesn't break right, pretty soon, I guess I'll land in the sanitorium or insane asylum. I guess we have stood this proposition off as long as we can. (*Reaching for telephone.*) Give me the Electrical Department. (*Pause*) That you, Red?

(*Pause*)

Come up here, will you? Had another accident in Department 42. Makes the third this week. (*Pause*) We have put this thing off as long as we can. (*Pause*) Yes, come right up. Quick as you can. Bring the plans up with you. (*Hangs up phone. A minute passes while F. Supt. rumples hair and fusses with desk papers, etc.*)

Enter electrician sauntering and whistling. He carries coil of wire pliers, dressed in working clothes, dirty face, etc., etc.

F. Supt.: Smith has had another accident in that Department of his down there. He says we've got to have more light down in 42—about twice as much as we've got now.

Electn.: Say, Chief (*belligerently*), that guy Smith is cuckoo. We had 60 watt lamps over each machine down there. He said there wasn't enough light, so I put in 100 watt lamps. Does he want me to put in 200 watts over each one? You'll have to rip out the whole wiring if you do. Some of it'll fall down if you touch it, too. Besides chief— (*Telephone rings. F. Supt. picks up the receiver impatiently.*)

F. Supt.: Who? (*Pause*) From Quick Lighting Company? (*Pause*) Never heard of them. (*Aside to electrician*) Salesman from Quick Light Company—Ever hear of 'em? I suppose it's another one of these peddlers coming up here with his order book. Send him up. (*Hangs up receiver.*) (*Enter Quick Light Salesman, breezily, flourishing non-descript lighting fixture.*)

Q. L. Sales: My name is...... What's yours? Pleased to meet you, Mr....... (*mispronouncing factory S.'s name*) I have a little proposition I want you to look over. I'm telling you its a cuckoo. Yep-Beauty. I understand you are in the market for a few lighting fixtures in this place and I have one here that is a bird. Look this over. There you are. That's the best factory lighting outfit that is made to-day. Cheap. Ain't that the bear's brassiers?

F. Supt.: Well, what will it do?

Q. L. Sales: You have to have a shade for it. I haven't my shade holder over here, but there is a shade goes over that. (*He waves fixture about, holding it before superintendent's face.*) Is this your electrician over here?

Electn.: Chief electrician. Who makes that thing?

Q. L. Sales: The upper part of this is made by the U.S. Can Company—yes, sir—and—

Elect.: What do you have to do when you fix 'em—go around with a can opener?

Q. L. Sales: The lower part—this globe here, is made by the Goldfish Glass Company. That is the real unit for your place, and I want to tell you some prices on this thing.

F. Supt.: What will that light do? Tell me something about it. Explain it.

Q. L. Sales: What will any light do? If you put a big bulb in it will give a lot of light. If you put in a small one, you ain't going to get so much. The beauty of that thing is that you can put any size lamp in there, from a 10 watt up to a 625 watt lamp. Yep—takes anything. And this glass here is made so thin you can see the lamp right through it when you get it burning. Smooth, too, ain't that pretty?

F. Supt.: That ought to be pretty efficient.

Q. L. Sales: Efficient, well, I should smile. Another thing, it is round. It throws the light out in all directions. It doesn't throw it just down, where it hits the floor, but throws it all over, best thing in the world for an office.

I'll tell you what we can do with this (*growing confidential*). I'm not giving everybody this figure, but we can make you a price on a quantity. How many could you use?

F. Supt.: How many of those could we use, Red?

Electn.: We need 200 fixtures, but not 200 of those things.

Q. L. Sales: Two hundred—well, that's different, you ought to buy 300 to get the maximum discount and use the other 100 up at some other time. You know, if that gets broken, you will need spares. But that thing will work just as well without the globe. In fact, it will work better. Nothing for bugs to

collect in, then. Use it either with or without.

F. Supt.: I was wondering how that would work in a machine shop.

Q. L. Sales: Specially designed for machine shops. It will work just as well without the globe, too. Nice and bright.

I'll tell you what we'll do. Let's get down to business here. Three and a half apiece for 300 lights. You can only use 200, but we'll figure three and a half a piece and 300 lights. For anybody else it would be five bucks, but we'll make it three and a half this time. What do you say?

F. Supt.: Not so fast, not so fast. You had better let Red and me figure this out. You leave your sample here and we'll go over it and you can come again in about a week.

Q. L. Sales: Come on, put your John Henry here (*slaps down order book*). Three bucks. That's my last go.

F. Supt.: No, you leave your sample here and we'll look it over.

Quick Light salesman walks over to electrician and slips him a cigar, factory superintendent busy with papers.)

Q. L. Sales: (*To electrician*) You fix this up and there's more in it for you. Go ahead. It'll be all right. So long.

Electn.: It looks all right to me chief (*picks up fixture*).

(*Exit Quick Light salesman.*)

F. Supt.: I wonder if that bird knows what he is talking about anyway?

Electn.: That price is pretty cheap. That's a good chain on that fixture too, chief.

F. Supt.: Cheap—that's what they all say. It isn't a question of how cheap the thing is. We can't seem to get anything in here that will do the work. Tried several "Cheap" fixtures already.

Don't you know anything about lighting a factory, or anything like that?

Electn.: Sure. Look how long I've been doing it.

F. Supt.: There must be a right way to do it. What are we going to do about this?

Electn.: Oh, there's lots of trick ways to do that, but our system puts light down close to where you work—saves climbing on ladders. This fixture looks pretty good, though. Say, chief, that elevator motor is shot again, you know.

F. Supt.: Damn the elevator motor. We've got that lighting here to take care of. That factory inspector was around this morning looking over the place to see if we had all the machines guarded. He said something about the law on lighting and shoved a book at me and told me to look it over when I had a chance. I just took a peek at it and it says we have to have so much light, but I don't know how to get it. He said that if we'd cut out gloom and glare we'd cut down doctor bills. He's started me wondering if—

Electn.: He's cuckoo. We got more light now than we need. In that one machine shop they had 60 watt lamps, and they said they didn't have enough light. Some of them wanted 100 watt lamps, so

I put them in. Then those birds smeared grease all over them because they said they were getting too much light. Some of them weren't getting enough and some of them were getting too much. Some of them put paper bags over their lights. Others hung rags over them. They don't know what they want. If we put in larger lamps we are going to have more wiring. Now that elevator motor—

(*Telephone rings*)

F. Supt.: (*Picking up telephone testily*) What another? Tell him I won't see him. I won't have any chance to work if I see them all. (*to electrician*) Another peddler to see me.

Electn.: What's he doing, lighting?

F. Supt.: Yes.

Electn.: Let him come up, chief. We can use up his cigars anyway.

F. Supt.: (*Talking into telephone*) Alright, tell him to come up. Another one of these order hounds, I suppose. (*A minute passes, while they discuss the virtues of the 60 watt lamps.*)

Enter Progressive Company salesman with large black case. Also foot candle meter, or small picture projector.

F. Supt.: Gosh, what are you a bootlegger?

Prog. Sales: Good morning—is this Mr. Superintendent?

F. Supt.: Yes.

Prog. Sales: (*Placing case on floor and meter on table*) We might wish that were scotch or rye. Unfortunately, it isn't. There is something in there, though, that I believe is better than scotch, Mr....... I will soon show you what I have in that case, but before I do I would like to tell you a story.

Electn.: Another story?

Prog. Sales: This is a true story this time.

F. Supt.: See how far he gets with this one.

Prog. Sales.: I was going past your factory to-day, Mr....... and I looked in the window. I think I saw there the reason why you are having so much trouble in your plant.

F. Supt.: Listen, don't start to tell me how to run this plant. I've been running it successfully for ten years without your help.

Prog. Sales: I don't doubt that at all Mr....... One can usually size up a man who is capable of running a plant,—and it's a profession these days. But perhaps I can help you run this plant ten years more. I think that you have run it successfully in the last ten years because you have been progressive. You have kept up to date and I am here to join forces with you so that we will be able to show some of these competitors of yours how to run a plant efficiently—smoothly, like a well-oiled piece of your machinery.

Let me ask you a question. Do you have any thermometers around your factory?

F. Supt.: Sure.

Prog. Sales: What do you use them for?

Electn.: I'll bite. What do you use them for? (*beginning to appear interested*).

F. Supt.: Well, what is the catch?

Prog. Sales: Now, it is a funny thing, but a great many people hang

up thermometers, and they measure temperature with them. Of course, some people use them as rulers. Some spank babies with them, and others put them to various uses. But you use a thermometer ordinarily to find out just exactly what your heating or cooling system is doing, don't you.

F. Supt.: Yes, but what's that to do—

Prog. Sales: Well, if you didn't have a thermometer, you wouldn't know whether your factory was too hot or too cold, would you? In other words, you work to a definite measurement. Certainly. You know that your operators couldn't work at their best under Tropical heat or Arctic cold, and so you run your plant and your ventilating system and your heating system in accordance with these particular measurements of temperature.

Now I am going to show you what we call the "thermometer of the lighting business".

Do you know that you can measure light? There is a little instrument that I call the Illumination thermometer. That is also called a foot-candle meter. (*Opening foot-candle meter case and showing instrument.*)

Electn.: That's a hell of a looking thermometer.

F. Supt.: How does it work?

Prog. Sales: Well, before I tell you how it works, let me assume that instead of light coming down from above, you have snow falling on this table. You would measure the thickness of the snow with a yard-stick, wouldn't you? And you might say it was one foot thick. That is simple. Even you can understand that, can't you. (*to electrician*).

Electn.: Sure—go ahead.

Prog. Sales: In order to find out the "thickness" of light falling on this table, if I may put it in this way, we measure it with this little instrument here. We can find out just exactly the thickness of light-fall or the illumination on this table or any place in your plant.

Now, this instrument has a scale here, you see, that has a series of dots on it, and when we set this pointer on the meter scale, as marked here, you will notice that on one side of this scale these dots are dark and on another side white. Somewhere at about this point (which is three, I believe, here), there is a change from light to dark, or these spots at the balance point disappear (*explains foot-candle meter*).

That shows you exactly what the illumination is on this surface and we can call that illumination foot-candles. It is just as simple as the degrees on the scale of the thermometer.

One thing that I think you should know about your factory is just what your lighting is, before you undertake to make any changes.

Electn.: That's a good line of bunk but what's the use of spending money on some trick "thermometer" when anybody can see whether they got enough light or not?

Prog. Sales: The peculiar thing about lighting is that it is almost impossible to guess correctly as to the amount of lighting you are getting.

Electn.: That's a lot of bunk,

chief. Wait a minute. (*Picks up telephone*) Hello, dearie, give me Joe Guiseppe—that you Joe? This is Red. Say Joe, those 60 watt lamps give you lots of light, don't they?

Sure—No I won't be over to-night. Got to go to choir practice. (*Hangs up receiver.*) Sure, he says he's got enough light, and Joe's the dumbest guy in the plant. If he knows, the rest of them aught to.

F. Supt.: Do you chase that instrument around in different places, slap it down, and find out how much light you have?

Prog. Sales: You can put it against the wall, or any place in the factory and then you make up a record and list just what the illumin-nation values are in the various working places in your plant. And I can very soon show you—

F. Supt.: How much does this thing cost?

Prog. Sales: You can get those from any Mazda lamp manufacturer for twenty-five dollars, and I don't know of anything so useful that is quite as simple and quite as cheap. There (*pointing*) is the battery, there is the lamp in this case; there is the little resistance; and there is the voltmeter.

F. Supt.: (*Addressing electrician*) Do you think you could learn how to use one of those things?

Electn.: Sure, if you are going to buy all those other fixtures though, you won't have much left to get instruments. Let's go ahead and guess the light Joe Guiseppe knows—

F. Supt.: But how is he going to tell? Can he tell, with his bare eye, how much light he has around, without one of those things?

Prog. Sales: Unfortunately, he cannot. The eye merely takes pictures. You can't take a Kodak that you use for ordinary photographic work and measure the amount of light with it. The Kodak just records an impression. It just "takes pictures". Doesn't it? The human eye is just like that, and we humans are all two-lensed motion picture cameras. And if you use this eye like you use a Kodak, you will take better optical pictures if you have more light, and poorer pictures if you have less light.

It is very simple to understand, isn't it, Mr....... That if in your plant you don't have enough light to take these eye pictures, your operators won't be able to see very well? And that may be one of the reasons why you get this sort of production record (*referring to figures or curves on blackboard*), or why these accidents occur.

F. Supt.: We had an accident here just a little while ago. We are having accidents here all the time. Just what relation is there between the intensity of light—or light-fall, as you put it a little while ago, and accidents?

Prog. Sales: Well, one of the best answers to that, I believe, is for me to ask you why you wear glasses.

F. Supt.: So that I can see.

Prog. Sales: Exactly. If you did not have those glasses you wouldn't be able to see as well. Perhaps I may even say that the reason you wear those glasses is because you or your parents strained your eyes, you tried to see with insufficient light.

F. Supt.: Do you mean to say that if my parents or my teachers had known that I was working under poor light and had endeavored to improve the lighting conditions I might not have to wear glasses to-day?

Prog. Sales: Possibly. And one of the very first things that we have based all factory lighting arguments upon is the fact that there are different degrees of seeing, based upon different amounts of illumination.

F. Supt.: I know, but seeing is seeing, and that is what you have your eyes for.

Prog. Sales: Oh, yes. But we have discovered that if you see detail under a certain illumination, say that which we have on this desk (an illumination of three foot-candles) that if you double or treble this amount of light, you will see very much better. That is a peculiar thing. Just "some light" isn't enough.

F. Supt.: Maybe this has something to do with all that spoilage item which runs so high with us.

Electn.: We had a man around here five years ago and he recommended a bunch of different lighting systems. We junked the old affair and put in a whole lot of stuff and spent about a thousand dollars altogether on it. We got stung once. Why not leave well enough alone.

F. Supt.: Well, I don't know. Maybe that was our fault. But the trouble is you never know what is the right thing and what is the wrong thing.

Prog. Sales: Mr. Electrician, you remind me of a fish story when you say that you have tried this business of improving your lighting and haven't had much luck with it.

You know down at the Battery in New York there is an Aquarium.

Electn.: I've seen it. Full o'suckers.

Prog. Sales: There was a man who had a big glass tank of water down in that Aquarium, and he put a bass in the tank and also a lot of minnows. After the bass had eaten two or three minnows, this man slipped a vertical sheet of clear glass down so that he separated the bass from the minnows, and every time the bass tried to go after the minnows he bumped his nose against that piece of glass. After two or three attempts the bass decided that business was rotten. He was a sorehead. He had learned his lesson. He had tried to get a minnow and he couldn't so he gave it up. He managed to eke out a poor existence eating the mud and stuff like that on the bottom of the tank. After a little while this man pulled out the sheet of glass and then that bass swam all around among those minnows but wouldn't bite one. Not on your life. He had "learned his lesson". He knew business was rotten and he wasn't going to butt into those minnows and get his head bumped. He was starving, but he still was determined to "let well enough alone".

Now, perhaps you have been just a little bit like that bass. Maybe you think you have learned a lesson in lighting, but perhaps conditions have changed, and what was good eight or ten years ago may be all

wrong—altogether inadequate—to-day.

Some of these reflectors I saw through the windows of your plant were of about the vintage of 1890 or 1895. I expect the situation is a good deal like that story about the man who was laughed at because he wore a hat that he had gotten when he was a boy. Lamps have grown up, and some of those big lamps you are using have reflectors that are in about the same state of inaptitude as would be a boy's hat on a grown man.

F. Supt.: That hits us all right, I guess.

Prog. Sales: In addition to this question of illumination (and I wonder if I can take just a little more of your time) I would like to show you a couple of things. There is something else the matter with your plant, Mr....... When you tried for sufficient light and you put on these shallow reflectors or used these bigger lamps that your electrician was speaking about, perhaps your main trouble was glare. Don't you think so?

F. Supt.: I guess that is the reason why those fellows slopped the bulbs all over with grease.

Prog. Sales: Do you know what glare is? Do you realize that if you took a Kodak and pointed it at the sun you couldn't take a picture? You know that, don't you? Let me show you what happens in your plant when you have a condition like that. May I borrow the help of your electrician for a minute? I would like to show you what I mean by this subject of glare.

(Connects glare box, or a bare lamp for purpose.)

Let me put this box on the table here. I have a little demonstration that I think will be worth while showing.

This is the way that we can show what we are talking about. If you will place the plug in, Mr. Electrician, I would like to demonstrate something here, because seeing is believing. I don't believe in discussing this subject without some definite proof of what we are talking about.

You know, illumination is a very peculiar subject. It is just of recent years that we have discovered some of the peculiarities about it. For example, I put a little chart in this box. You can see that there is certain printing on it. It says: "Glare from bare lamps reduces ability to see".

I wouldn't be surprised if the trouble in your plant was just that. For example, if we put a fairly bright light in back of the hole in this card we cannot see the printing on it quite as well as we did before, and if we increase the brightness of that light you can readily appreciate how difficult it becomes to read printing on that chart, isn't that true?

F. Supt.: Can't see a darn thing on there now.

Prog. Sales: No, sir. Isn't that the reason why your plant operators and your men in the factory are suffering from this trouble of glare?

F. Supt.: By gosh, I think he has got it, Red.

Prog. Sales: Wouldn't it be very easy for you to stick your fingers in the gear, or get your necktie or

overalls caught in a belt or something of that kind, if you had a condition of glare to work against? You see, when you brighten that light how it reduces your ability to see. Isn't that simple?

F. Supt.: Yes.

Prog. Sales: While I have this little cabinet here perhaps I can show you something else. The basis of good factory lighting consists first, in having enough light as you measure with this little "thermometer" or foot-candle meter and second in reducing this glare by the proper type of reflectors. I see you have some lying around here. There are three or four on the table and you have some more over here. This and others of a suitable type (*referring to RLM or similar reflector*) shield the lamp far enough down so that this bright light doesn't strike in the eye and that is one good way of reducing glare.

Before I continue that question of glare, I am going to show you something else important for you to know and that is this question of shadow. It is a pleasure when I find people of your intelligence who can understand this demonstration. I go around and talk to quite a few people and they don't pause long enough to understand what I am talking about, but you can readily understand all this, of course, can't you?

It is pretty light in here; perhaps we had better pull down the curtains and just darken this room slightly. I can put light on those sticks (*demonstrating direction of light*) from the left and you can readily see that they are different shapes, or if I put light on them from the top, or from the right or from the bottom, you can get the effect of the definition or shape of the sticks; whereas, if I put light on those sticks from all sides you can't see the shape of them as well.

F. Supt.: That means there is a certain place where we ought to put the lighting fixtures.

Prog. Sales: Absolutely. You must take into consideration the question of the direction of light, and the shadow.

F. Supt.: How do you handle that, Red?

Electn.: We put a 60 watt lamp over every machine.

Prog. Sales: Exactly, and if you have a 60 watt lamp over every machine, you might (*showing shadow effects*) have a condition like that; whereas if you put that 60 watt lamp at some particular place (say at the right or left) it might throw the shadow in exactly the right way. That demonstrates very readily I think what we mean by shadow and by direction of light.

Electn.: (*To Superintendent*) We are getting a lot anyway, aren't we?

Prog. Sales: While we are on this subject of shadow. I would like to show you one other thing. We have other little demonstrations of this kind. But take just such a simple thing as that (*demonstrating a plaster head*). Now you can understand what I mean by the flatness of an object as compared with the direction of lighting. We can almost make that figure move if we put light on it from one side or the other.

Electn.: How much does this thing cost?

Prog. Sales: This particular demonstration cabinet? Why, you can buy that for $100 complete, with all accessories, and I think that every good salesman ought to have one.

F. Supt.: (*To electrician*) What would you want one of those things for?

Electn.: To experiment with?

F. Supt.: You better experiment on your lighting.

Prog. Sales: I believe that modern salesmanship, high class salesmanship, will in the future depend on things of this kind, because I can here show in a very few minutes what I couldn't tell you in several days.

Electn.: What are the rest of these for? (*he tries various switches, etc.*)

Prog. Sales: I see the electrician is of an inquiring nature. He can try something else interesting.

For example, if we are discussing factory lighting, in addition to the question of amount of light and direction of light, shadow and glare, we ought to discuss questions of color. Did you ever think about the color of your lighting? I'll bet you didn't? You probably just put in "some" lights—

F. Supt.: No, I never thought about that.

Prog. Sales: Certainly not. Suppose we have a red colored light on pieces of fabric of that kind (*demonstrating*), and suppose we change it to blue or to green. See what a tremendous difference it makes?

F. Supt.: It looks like different stuff.

Prog. Sales: Suppose you had a colored light like that over in your printing plant and you were trying to match colored inks or papers, wouldn't you find that your spoilage would run up because you couldn't detect differences of color?

Electn.: They have a lot of trouble over there on that, too.

F. Supt.: I'll say they have.

Prog. Sales: We will take, as you say you have a problem in the printing plant, other objects of that same character. Take a simple object, like that colored card there. You can appreciate the difficulties that people are going to have with that. That card apparently has black squares on a pink background, or green squares on a yellow background, or dark blue on a reddish background, or about five or six different combinations of colors.

F. Supt.: By gosh, I always thought that printer was color blind.

Electn.: Try this one (*fussing around with the device*).

Prog. Sales: Suppose in another part of your plant you are handling brass and copper, you can readily see what will happen. Those colors of objects change as the colors of light on them change. Suppose your man working with brass and copper down in Department 31 uses brass instead of copper, or vice versa; it will be because he won't see what you see there. Don't you see how the choice of color may lead you to increase your production and decrease your spoilage?

F. Supt.: We have always tried to do that in daylight, but is there any way in which we can do that when we don't have a bright day?

Prog. Sales: Daylight is very changeable. You cannot trust daylight. Further more, you can't control daylight, and I might even say that daylight costs you money.

F. Supt.: Costs us money? Daylight.

Prog. Sales: Yes, sir. Do you know that daylight is expensive? It has been calculated, Mr....... that daylight sometimes costs more than artificial lighting.

F. Supt.: What are you talking about? That is like the air, it is free.

Prog. Sales: I used to think so. Even air costs you money these days because you have to put in ventilating fans and you have to pay salaries to the electricians to keep those fans going. If you put windows in your factory, it costs money to cut and glaze the sashes and put those windows in.

Electn.: (*Experimenting*) Look, chief.

F. Supt.: You'll bust that yet.

Prog. Sales: It will cost you more money to put in window glass than to build a concrete wall. Then you have to pay for the breakage and cleaning of those windows and you have to pay for the heat that radiates through them. And on top of all that you have dirt coming through those windows. You have all sorts of complications which, when figured out, lead you to the conclusion that daylight costs money—usable daylight especially. Furthermore you can't get daylight in the middle of your factory as you can along the windows. And that is one reason why you really need good artificial lighting even for daytime operations.

F. Supt.: Let me ask you a question. Is there a certain amount of light necessary for different kinds of work?

Prog. Sales: Oh, yes. There is a Code of Lighting. There is an organization called the Illuminating Engineering Society which has drafted a code of factory lighting, and in conjunction with several other societies they have printed this bulletin.

F. Supt.: (*Picking up pamphlet from desk*) That is what this thing is.

Prog. Sales: That is the bulletin you have on your desk. That is a very important thing, Mr....... because there are factory inspectors who may be coming around pretty soon, and, while they really will caution and guide you, yet if you don't live up to the law you are likely to be criticised and perhaps fined.

F. Supt.: I'll say they're coming around.

Prog. Sales: Under this general subject of "Values" you will find a table that tells you how many foot-candles you should have in order to be within the law, and how many to be up-to-date.

F. Supt.: Take a look at this, Red. How much have we got down there in Department 42?

Electn.: We have a 60 watt lamp over every machine.

Prog. Sales: Take that little instrument down there and you can measure it and find out exactly.

F. Supt.: Look here, you have told us a great many things. I had begun to think that this stuff was a lot of bunk but maybe there is something to it. How would you

like to give us a hand here and tell us something about this? (*picks up blueprints*).

Electn.: There is another thing. With our drop cord fixtures we are furnishing the whole community with lamps. They steal 'em. One thing about this here is that nobody would ever steal this. (*referring to sample left by Quick Light Sales*).

F. Supt.: They would break that and get a good lamp. We lose a lot of lamps, you know, through breakage and theft. What fixtures will prevent that?

Prog. Sales: Mr....... before I discuss individual types of units, let me show you a couple of little pictures. I have a means of carrying pictures with me.

F. Supt.: Is that what you meant when you said you would tell me what my competitors were doing.

Prog. Sales: I have an outfit here by means of which I can show you what I mean. This is another idea in high class selling that I think it is worth looking into. If we can pull those blinds down again and darken the room a little bit, I will show you the kind of things you will find in other parts of the country.

For example (*showing Bray pictures*). This is a picture of a printing plant—"correct illumination will increase production from five to thirty per cent".

You will remember this production curve you have over here. It will decrease spoilage.

Electn.: How do you know that?

Prog. Sales: By measuring and by the experience of people in other plants. I will tell you about that in just a moment. (*throws on another picture*)

F. Supt.: That is what I am interested in.

Prog. Sales: "Big reduction in accidents." That is because we have learned that speed of muscular motion depends on the speed of vision, and when you can take snapshot eye pictures as you take snapshot Kodak pictures, you will move accordingly—quicker. And if a man has a ladder falling over on him and he doesn't jump, it is usually because he hasn't been able to see it quickly enough (*he continues to read titles of pictures*).

"Money cannot buy a human life, nor compensate a cripple."

"Correct illumination produces cheerful surroundings."

F. Supt.: That will reduce our labor turnover, you mean?

Prog. Sales: You would certainly have fewer people going to your competitors if you gave them nice places in which to work.

Electn.: Don't shoot those things through so fast.

Prog. Sales: You want to read those titles over?

Electn.: Sure.

Prog. Sales: Which plant do you think is the most efficient and has the best working conditions, this one which is a fine example of light where you do not want it.

F. Supt.: That looks like one of ours, Red.

Prog. Sales: Or this, which is the same place after it has been properly lighted. Doesn't that seem like a radical difference?

F. Supt.: Are you sure that wasn't taken in the sunlight?

Prog. Sales: No, sir, it was not.

It is a picture of the ......Mills. That is the kind of lighting that should exist in your plant.

Electn.: That is where we have the 60 watt lamp over every machine (*indicating*).

Prog. Sales: That is the way it looked after it was lighted properly.

F. Supt.: Say, Red, why can't you do a job like that?

Electn.: I can't keep up on all that stuff, chief, when I have that elevator motor shot again.

Prog. Sales: Before we pull up those blinds and let in daylight I would just like to try something else here to show you what I mean by using the proper lamp equipment. You have some samples here that I think you will be interested in. Let us take these Mr. Electrician. (*Picks up two similar reflectors.)*

These reflectors are of a usual type, both alike, but I am going to show you a difference here. Will you just hold your arm up against that screen there, about a foot or two away from it? (*Electrician holds up his arm as directed.*) Notice the shadow from that unit, and notice the shadow from this unit. Do you see the difference? What do you suppose the difference there is? Do you see that lamp? That is coated over the lower part. It is called a white bowl lamp.

F. Supt.: It looks like whitewash.

Prog. Sales: That is the kind of lamp you should have, and not this kind, if you want to get away from sharp shadows.

F. Supt.: What do you put that on there for? (*referring to the white coating*).

Prog. Sales: That is to reduce the glare and soften the shadows. You can see the difference between those units. The softer shadows are those caused by the white bowl lamp bulb.

I could go on and give several other illustrations if I had the time, but I think you had better let me do something a little out of the ordinary for your plant. Why don't you let us look this plant over and see if we can lay out a lighting specification for you?

F. Supt.: Say, what is this service going to set me back?

Prog. Sales: You mean how much are the lighting units going to cost you that we may recommend?

F. Supt.: Yes.

Prog. Sales: Mr....... when you get up in the morning do you refrain from taking a breath of air until you find out how much the air costs?

F. Supt.: No, certainly not.

Prog. Sales: And do you keep the curtains down until you discover how much the sunlight may cost?

F. Supt.: No.

Prog. Sales: Certainly not. Those are things that you need. You take them because they are absolutely necessary, and I am not going to discuss cost of lighting fixtures with you because—

F. Supt.: There's something the matter with this fellow, Red.

Prog. Sales: If your wife were very sick and she needed to have an operation performed, would you ask the doctor how much it was going to cost to save her life before you took any steps towards doing so?

F. Supt.: No, but—

Prog. Sales: And if your plant is sick, you don't want to discuss how much it is going to cost to save your plant.

F. Supt.: I guess that is the right way of looking at it.

Prog. Sales: The cost of oil that you use to save your machines is more than the cost of light.

F. Supt.: It is plenty.

Prog. Sales: Nevertheless, you wouldn't let a machine go dry for lack of oil would you? Five cents' worth of oil may save a five hundred dollar machine, and the extra cost of good lighting as compared with poor lighting is less than the cost of oil.

F. Supt.: I guess that is pretty nearly the right way of looking at it.

Well, you say there is no trick to this. How am I going to know how many lights we want? And where are we going to tell Red to put them so that we can get this direction business that you were showing me, and so that we can cut these shadows down, and all that kind of stuff? How am I going to know all these things? Can you give us some kind of a plan to work by?

Prog. Sales: Yes, sir. No good company these days wants to merely sell you equipment. I represent a progressive company and we want to see that everything that is used is used properly. In order to do that I would like to be sure that we know the conditions in your plant so that we can lay out a lighting job specifically applicable to your location. For example, these metal reflectors will be all right for certain low spacing and general illumination. The prismatic reflectors over there are the kind you may want for high mounting height over your craneways and your narrow bins. For the offices, perhaps white glass shades of globes. There are other types of reflectors for local lighting, and that sort of thing. You cannot go at this haphazardly.

You know, I saw a competitor of yours and he reminded me of a story about a man who found that there were a lot of moths in his clothes closets. He went to the drug store and the druggist said, "What you want to do is to buy some moth balls". He saw this customer of his passing and he stopped him and asked, "How did the moth balls work"?

The customer replied, "I don't think much of them. I sat up throwing moth balls at those little butterflies all night and I never hit one".

Now don't misuse these lighting devices in that way. Let's be sure we have the right thing for the right job, used rightly.

Let me read a couple of testimonials here just to show you that you are really contemplating nothing out of the ordinary. This is from Harry S. New, Postmaster-General. He says:

"I would like to have it understood that it will be my policy to make the lighting of the Canadian Post Offices sufficient and proper in order that no one will be compelled or permitted to work under any possible eye strain or injurious conditions."

F. Supt.: New said that?

Electn.: What size lamps do they use?

Prog. Sales: Well, if Parliament

doesn't give them more appropriations, I am afraid they will have to install lightning bugs.

Let me read to you what Mr. Crichfield, of the Shelby Sales Book Company, says on this subject:

"We have gone to considerable expense to have the most up-to-date lighting, not because of night work, but to have light of the right kind and right amount through the early morning and later afternoon and on cloudy days."

Isn't that important?

The Timken Roller Bearing Company have increased their production 12½% by simply increasing their illumination.

F. Supt.: That will take care of that production curve there, Red.

Prog. Sales: You have worn Cluett-Peabody (Arrow) shirts, probably. Here is what Mr. Cluett says:

"We have realized for many years that to produce the highest quality of work it is of first importance that proper illumination be given to all parts of our plant."

That is important, isn't it?

I could read three or four more like that. So that you are not out of line if you are going after factory lighting to increase production and decrease cost.

F. Supt.: We are after both of those items.

Electn.: We have one job down here in particular that I would like to get some dope on. The fellows said they didn't have enough light down there with 60 watt lamps over each machine, so I gave them 100 watt lamps. Some of them still kicked, so I gave them 200 watt lamps. I don't know what is the matter, but they smeared grease all over them because now they say they have too much light. First they didn't have enough light; now they have too much light.

Prog. Sales: I expect they don't have light in the right place.

F. Supt.: If you make out plans, and so forth, how much are those plans going to cost us?

Prog. Sales: Not a cent. We are prepared to give you that service or any competent consulting engineer will give you that service, or sell it to you, and you could well afford to pay for it. But let me take these blueprints of your particular plant and I will lay out a diagram of this kind, and return these blueprints in a few days.

F. Supt.: You take these with you, and suppose before you go you take a look at the plant.

Prog. Sales: I think that is the proper way to do it. We will go down here to your plant and look it over.

As they exit, electrician, holding up sample fixture of the Quick Lighting Company says to F. Supt.:

"What'll I do with this, Chief?"

F. Supt.: Throw it in the waste basket. What I'm after now is a result. I'm after PRODUCTIVE ILLUMINATION.

Electrician throws fixture carelessly at waste basket, breaking glass globe.

(*Curtain*)

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in February, 1926.

Appliances

CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ont.

Electric Arc Welding Machine.

* * * *

CASSIDY'S LIMITED, (Submittor), 22 Front St. W., Toronto, Ont.

THE APEX ELECTRICAL MANUFACTURING CO. LIMITED, (Mfr.), 102 Atlantic Ave., Toronto, Ont.

Electric Vacuum Cleaner. "Cassidy's Limited".

Electric Washing Machine. "Cassidy's Limited".

* * * *

A. KENNETH COULTER (Submittor) 70 Lombard St., Toronto, Ont.

WARD MANUFACTURING CO. (Mfr.) 937-9 Wellington Ave., Chicago, Ill.

"Kumfy Kurl" or "K-K" Electric Curling Irons.

* * * *

BENJAMIN ELECTRIC MFG. CO. OF CANADA, LIMITED, 11-17 Charlotte St., Toronto, Ont.

"Benjamin" bell-ringing Transformers.

* * * *

HURLEY MACHINE COMPANY, LIMITED, 66 Temperance St., Toronto, Ont.

"Thor" No. 77 Portable Vacuum Cleaner.

* * * *

THE OSTER MANUFACTURING COMPANY, Station B, Cleveland, Ohio.

Motor-driven, Pipe Threading and Cutting Machine, ½ h.p. 110 V. 8A.

THE FRANK E. WOLCOTT MANUFACTURING COMPANY, Hartford, Conn.

Coffee Percolator Heater "Torrid".

* * * *

*ELECTRAD, INC. 428 Broadway, New York, N.Y.

Radio Lightning Arrester.

* * * *

*FISCHER & CO., H.G. INC., 2333-43 Wabansia Ave., Chicago, Ill.

X-Ray, Current Generators.

Marking: Nameplate with rating and type letter.

* * * *

*HALLIWELL ELECTRIC CO. INC., 115-119 Fourth Ave.,New York, N.Y.

Portable Electric Hair Dryer, Type E-40.

Marking: Nameplate.

* * * *

*JOHNSON CO. S.T. MFR., 1337 Mission St., San Francisco, Calif.

Johnson Rotary Oil Burner.

Marking: "Type 22" on etched brass nameplate attached to rear of blower housing.

* * * *

*KOKEN COMPANIES, 2500 Texas Ave., St. Louis, Mo.

Electrically-illuminated barber poles of the pedestal and bracket type. Cat. Nos. 141, 142.

* * * *

Fittings

VANCOUVER IMPORTS LIMITED, 328 Cordova St. West, Vancouver, B.C.

Current Taps.

Marking: "Peerless" and rating in volts and watts.

* * * *

*PROPP CO., THE M., 524-28 Broadway, New York, N.Y.

Current Taps, Cat. Nos. 1, 2, 4, 11, 22, 44.

Separable Attachment Plugs, Cat. No. 526.

Marking: "Propp".

* * * *

*LANGLEY ELECTRIC MFG. CO. LTD., 677-79 Notre Dame Ave., Winnipeg, Man.

Outlet Boxes and Plates. Cat. Nos. L-805 to L-807 incl.

Marking: "L E M Co."

* * * *

*MOON & CO., E. W. Youngstown, N.Y.

Outlet Plate, sheet-steel plate with clamps for flexible tubing, Type "I-B".

Marking: "Moon".

* * * *

Switches

*HARRINGTON-SEABERG CORP. MFR., 1708 Third Ave., Moline, Ill.

MAGNETIC SIGN FLASHER COMPANY OF CANADA, (Submittor), 110-112 Church St., Toronto, Ont.

Magnetic Sign Flasher, Types D-3A, 3D.

Marking: Nameplate with rating and type number.

* * * *

Portable Lighting Devices

THE ART SHADE AND STAND COMPANY, (Submittor), 57 Winchester St., Toronto, Ont.

WM. WOODS & CO. (Mfr.), 57 Boston Ave., Toronto, Ont.

Portable Electric Lamps. "Assco" or "Wm. Woods & Co."

* * * *

W. H. BANFIELD & SONS, LIMITED, 370-86 Pape Ave., Toronto, Ont.

Portable Electric Lamps. "Banfield".

* * * *

FRANKLIN POTTERY, Lansdale, Pa.

Portable Electric Lamps. "Franklin".

* * * *

MARBILART COMPANY, 1125 Federal Building, Toronto, Ont.

Portable Electric Lamps.

* * * *

MCDONALD & WILLSON LIGHTING STUDIOS, LIMITED, 347 Yonge St., Toronto, Ont.

Portable Electric Lamps. "McD. & W.L.S. Ltd."

* * * *

MUTUAL-SUNSET LAMP MFG. CO. INC., 21-25 East Houston St., New York, N.Y.

Portable Electric Lamps. "M.S. L. Co." or "M.L.Co."

* * * *

Miscellaneous

*CONDUITS COMPANY, LIMITED, Toronto, Ont.

Elbows for Rigid Conduit.

* * * *

*GARFIELD MFG. CO., Garfield, N.J.

Insulating Materials (As listed on Underwriters' Laboratories card dated January 26, 1918).

* * * *

*These devices are under the Underwriters' Laboratories Label or Re-examination Service.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

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Per Year

Power From Quebec to Relieve Shortage

THE Hydro-Electric Power Commission of Ontario has been actively engaged for a number of years in an investigation of the water powers of the Ottawa and St. Lawrence rivers, with the object of augmenting the supply of hydro-electric power to meet the expanding demands of the municipalities and industries in Ontario. More recently, it has been particularly engaged on an investigation and surveys of the water powers on the Ottawa river, pending the necessary authority and approval of plans to enable the Commission to proceed with the contemplated development of the St. Lawrence river. Concurrently with the Commission's investigation of the water powers on the Ottawa negotiations have been from time to time carried on with several large owners of water powers in the Province of Quebec, with the object of purchasing hydro-electric energy until such time as the Commission might proceed with its own developments.

The Commission is now gratified to report success in completing negotiations for the purchase of a large block of power upon satisfactory terms, and that upon the recommendation of the Commission the Government is pleased to authorize the completion of an agreement for the delivery of 230,000 to 260,000 horsepower of hydro-electric energy to the Commission at the Interprovincial boundary, in the vicinity of Ottawa, by the Gatineau Power Company, at a price of $15.00 per horsepower per year. The delivery will commence with a block of 80,000 horsepower in the year 1928, the total of 230,000 to 260,000 horsepower to be ready in the year 1931.

The Gatineau Power Company is a subsidiary of the International Paper Company, which is at the present time constructing power plants on the Gatineau river at

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Chelsea and Farm Point, from which developments certain amounts of power will be delivered under the above mentioned contract. They also contemplate developing at Paugan Falls, and other points on the Gatineau river, and providing storage on the Gatineau and its tributaries.

The power to be delivered to the Commission will be at a voltage of 230,000, which is the maximum voltage for which equipment may be obtained from the manufacturers at the present time. This power will be transmitted from a point near Ottawa to connect with the Niagara System near Toronto. The transmission lines will be approximately 230 miles in length and require an expenditure of from $10,000,000 to $15,000,000. It is estimated that the cost of the above mentioned power delivered to the Niagara System, at Toronto, will be from $7.00 to $8.00 per horsepower, less than the cost of producing a similar quantity of power, at the maximum load factor provided for, from steam plants at present prices for coal and equipment.

The contract for the above mentioned supply of power in the East enables the Commission, in addition to supplying power in sufficient quantities to meet the demands of the Niagara District, to provide for the needs of eastern Ontario between Ottawa and the Niagara District. The high tension transmission lines traversing the territory between Ottawa and Toronto will have a capacity of from 300,000 to 400,000 horsepower, and may be tapped at one or more points to meet the needs of the districts intervening, thus protecting the future demands municipalities and industries of the East.

In addition to the power to be supplied according to the foregoing and pending the completion of the St. Lawrence development, the Commission has under consideration the development of Chats Falls on the Ottawa river. The people and industries of Ontario are therefore assured of an ample supply of power for the next six or seven years.

Summer Convention, 1926

As noted elsewhere in this number, it has been decided that the Summer convention of the Ontario Municipal Electrical Association and of the Association of Electrical Utilities is to be held at the Bigwin Inn located on Bigwin Island in Lake-of-Bays.

Bigwin Island it appears, according to early history, was the favorite convention ground of the Indian tribes. Here they met in council under their Chief, Joseph Bigwin, whose remains now lie buried at one end of the Island. It was also the meeting place of the Whites with the Indians, a Hudson's Bay trading post having been established on the Island and maintained for many years. Bigwin Island has continued to be a favorite convention ground. During the evolution of time, the wigwams have been supplanted by a series of buildings of modern construction. These constitute a large hotel known as Bigwin Inn, provided with every comfort and convenience, and every facility for rest and recreation, and it is here it has been decided to hold this summer's convention.

Bigwin Inn may be reached either by Railway as far as Huntsville and thence by boat, or by motor to a point on the mainland opposite the Island and then by motor ferry. For the Summer Convention it is proposed that arrangements be made with the Canadian National Railways for transportation from Toronto to Huntsville, leaving Toronto some time late on the evening of Wednesday, June 23rd, at a time that will permit the arrival of trains from all parts of Ontario, prior to its departure. The Railway advises that for a party such as will leave Toronto on that evening, the return fare will be one and one-half times the single fare, pullman car accommodation being extra. The delegates will receive at an early date a statement as to the actual amounts they will be required to pay for this transportation. The Railway also advises that from other points in the Province where ten or more persons are being carried as a party, the same rate will apply as for the Toronto-Huntsville portion of the trip.

The train will arrive at Huntsville some time early Thursday morning, June 24th. At about 7 or 8 o'clock that morning the party will transfer to a steamer of the Huntsville and Lake-of-Bays Navigation Co., and be carried through the Muskoka River, Fairy Lake, Peninsular Lake and Lake-of-Bays to the Bigwin Inn. Breakfast will be provided on board the boat.

For a party wishing to reach the Hotel by motor, they are advised to travel north to Bracebridge, which portion of the trip is via Provincial Highway, and then in an easterly direction to a point on the south shore of Lake-of-Bays directly opposite the Bigwin Inn, the total being approximately 145 miles from Toronto. Here the automobile will be left at a location which is part of the Hotel property,

and the balance of the trip made by motor ferry, a distance of about one mile.

The rates at the Bigwin Inn are quoted as $7.00 per day per person, which covers everything provided by the Hotel including Banquets, Luncheons, etc., excepting only charges that may be made for use of the Golf course, boats and other such extras. For any that may wish to stay longer than the two days of the Convention, the Hotel advises that the same rate will continue up to about the end of the first week in July. Also in reference to the reduced fares to be granted by the Railway, these tickets will permit a return any time within ten days of their being issued—returnable on any train.

The Bigwin Inn, Lake of Bays. In the foreground are the dining room (right) and pavilion (left). In the centre are the rotunda and the two sleeping lodges.

In making a decision to hold the Convention at this point, the Convention Committee and the Executive Committee of the Association of Municipal Electrical Utilities have considered the question thoroughly and are convinced that the Summer Convention of 1926 will prove itself everything that could be wished for.

The Transmission of Pictures

WITH nearly every forward step in the advance of science, we hear predictions as to what the next important step will be. Following the development of highly efficient methods for the transmission of the human voice and music, by wire and by radio, it was perhaps to be expected that some means would soon be found for the transmission of pictures over considerable distances.

The general principles of picture reproduction by electrical methods over short distances has been known for some time. It is only within the last two years, however, that the American Telephone and Telegraph Company have developed a satisfactory system for the transmission along telephone lines of pictures, or other illustration material, to such distances as will give the transmitted picture an appreciable gain in time over the original picture sent by usual methods of transportation.

The advance copy is of particular value to daily newspapers in the illustrating of distant events within the same issue that contains the telegraphic account of the event. Also, the system can give valuable information promptly to detective and legal departments in transmission of finger prints of suspected criminals, hand writing for identification, for proof either of authenticity or forgery of a document, and there undoubtedly are many other uses of equal or lesser importance to which picture transmission may be applied now that the system has been established.

The high efficiency of the development is probably best realized by a study of the illustration of the Cleveland high level bridge, Fig. 1. At first glance, this appears quite the equal of a contact print from the original negative, but upon closer examination of the border lines of various lights and shades, there will be seen narrow saw tooth edges being the result of the method of reproduction. These evidences of reproduction are not as noticeable in the half tone cut however, as in the print from which this cut was made, so that the cut from a transmitted picture is nearly as good as one from the original photograph.

Many of the newer developments were used in the perfecting of this system for picture transmission; prominent among these are the photo electric cell, the vacuum tube amplifier, electrical filters and the use of carrier currents.

General Scheme of Picture Transmissions

There are three essential elements in the transmission of a picture, namely,—

(a) A means of converting the lights and shades of the picture into variations in an electrical current.

(b) A transmission channel, along which the varying currents may pass,—without distortion.

Fig. 1. Cleveland High Level Bridge. Variable density line picture (Picture Transmission—New York to Chicago).

(c) A means of reproducing the picture from the variations in the electrical currents.

The picture is not reproduced instantaneously but is woven, as it were, over a short period of time, about seven minutes.

The Transmitter

The transparent illustration for transmission is wrapped around a cylindrical drum, also transparent (Fig. 2a-"C") which slowly revolves on its axis. Inside this drum is an opaque stationary drum, with a small opening and containing a photo electric cell, P.

As the picture revolves, it also is moved slowly along its axis so that all parts of the picture pass over the small opening in the inner drum during the time required for transmission. The light rays from an enclosed lamp, L, pass through a lens, D, a screen, A, and a combination of lenses, S, and are then focused on the small opening in the inner cylinder, through which they pass to illuminate the interior of this cylinder and affect the photo electric cell.

The source of light is constant; therefore the light which acts on the photo electric cell will vary in intensity according to the lights and shades of the picture. The function of the photoelectric cell (Fig. 3) is to cause variations in the electric

current passing through it whenever the intensity of light is varied.

Thus the lights and shades of the picture become current variations, which then are amplified and caused to vary the strength of the carrier wave which travels along the telephone lines.

THE TELEPHONE LINE AS MEDIUM

The carrier frequency of 1,300 cycles is chosen in preference to direct current, or power, or radio frequencies, since it lies within the frequency band for which the telephone lines, loading coils, filters and repeating amplifiers give the highest efficiency and greatest accuracy in reproduction.

In this way the picture transmission equipment is rendered directly applicable to the existing telephone lines.

THE RECEIVER

When the carrier wave, varying in strength, arrives at the receiving end, it is first demodulated to produce variations in a direct current circuit. In this circuit is a small light valve (Fig. 2b-"V") which is actuated by the varying current and controls the light passing through the lens "S" to focus on a sensitized film on the revolving cylinder, C.

The receiving cylinder revolves in synchronism with the transmitting cylinder and also moves along its axis so that the focused spot of light covers the entire surface of the film during the transmission of a picture. The variations in intensity of light at the surface of the film being controlled by the lights and shades of the picture at the transmitting end, thus reproduce the picture as a series of parallel lines of varying width, or varying intensity, according to the adjustment of the light value and lens S, at the receiving end.

SYNCHRONIZATION

In order to insure the proper synchronizing of the transmitting

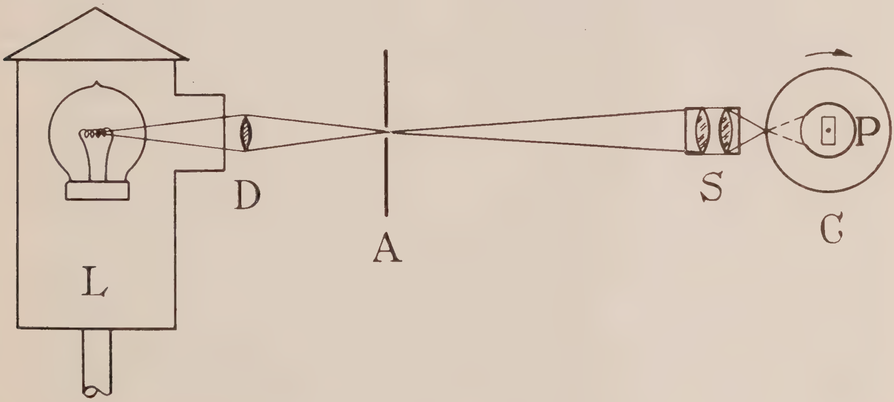


Fig. 2a. Sending end—Optical System.
L-Source of light. D—Condensing lens. A—Diaphram. S-Projection lens. C.—Picture film on transparent cylinder.

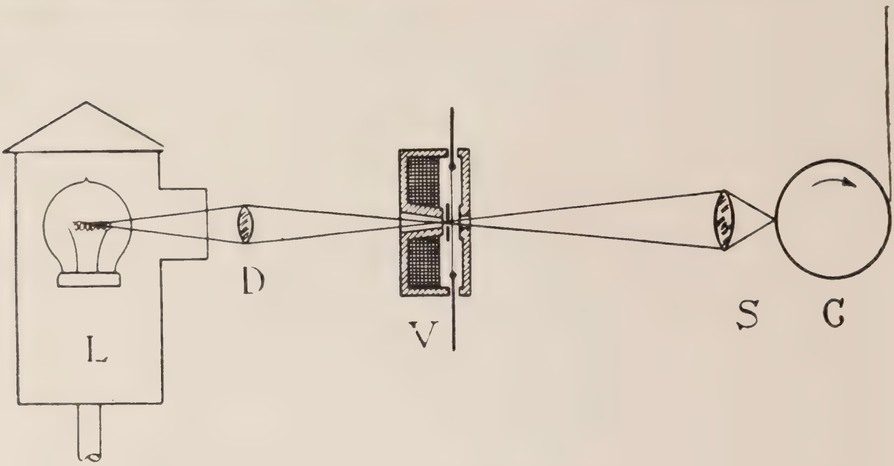


Fig. 2b. Receiving end—optical system.
V—Light Valve. C—Sensitive Film.

and receiving cylinders, small motors, known as phonic wheels, are kept in step by the impulses from a single tuning fork at the sending end. These impulses are sent to the receiving end by means of a carrier wave of other frequency than that used for the transmission of the picture itself, thus permitting both picture and synchronizing currents to be passed along the same pair of telephone wires without interference of one with the other. The currents are kept separate by means of electrical filters at the sending and receiving ends.

Characteristics of Reproduced Pictures

The transmitted pictures may be reproduced by varying either the width, or the intensity of the line traced on the sensitized film by the spot of light which the valve controls. Where the valve is placed close to the film, or an image of the valve is produced on the film, the line traced out will vary in width but not in intensity, whereas if the valve itself be out of focus, the line traced will have constant width, determined by the size of the small

Fig. 3. Type of photo-electric cell used in picture transmission.

opening in the opaque cylinder covering the film, but will vary in density.

Either method will trace out the same picture but the former lends itself to quick reproduction on cuts

Fig. 4. Transmitted variable width line picture, enlarged.

Fig. 5. Electrical transmitted news picture, variable width line system—President and Mrs. Coolidge.

for printing purposes, whereas the latter gives a result from which a half tone cut may be made.

Varying Width Line Pictures

An enlarged reproduction by the varying width line is shown in Fig. 4. On close inspection, the details of the picture are lost, but when held at a distance the lines blend to give a soft picture with considerable detail.

In practice a fairly fine line is used, producing the result of Fig. 5. A cut may be made directly from this type of picture, i.e. without using the screen required for half tone work.

Varying Density Line Pictures

In Fig. 6 is shown an enlarged portion of a picture reproduced by lines of constant width and varying density. When this picture is held at a distance, these lines blend to produce a soft effect, much the same as the original photo.

The illustration of Fig. 1 is a varying density line picture and serves to show the high grade of picture that may be expected from this system.

Application of Picture Transmission

As these methods of transmitting pictures will produce good results

from photographs, it would be assumed that equally good results would be obtained from illustrations which are not so fine in character,

Fig. 6. Transmitted variable density line picture, enlarged—Part of Portrait of Micheal Faraday.

e.g. pen and ink sketches, cartoons, plans and diagrams. With this latter type, accuracy is necessary but the fine tones are not required, and, when absolutely true reproductions are obtained, these may be of much more real value in the commercial world than transmitted photographs. These methods, therefore, have various applications.

The transmission of signatures, Fig. 7, may save considerable time and expense in identification of original signatures on cheques, deeds, contracts and other documents where otherwise there would be a costly delay. The time alone saved by the transmission of a signature may be invaluable in a case of suspected forgery.

Japanese and Chinese characters are about 9,000 in number and do not lead themselves to transmission by telegraph. Here again, Fig. 8, the picture transmission equipment will supply the need and give the necessary accuracy.

Picture transmission equipment also may be applied to the transmission of information for the use of detective and police forces, in sending finger prints, Fig. 9, as well as the usual identification photographs.

The reproduced pictures illustrated above were transmitted from New York to Chicago over a single pair telephone line through all of the repeaters, filters and loading systems on this circuit.

Similar stations were placed in

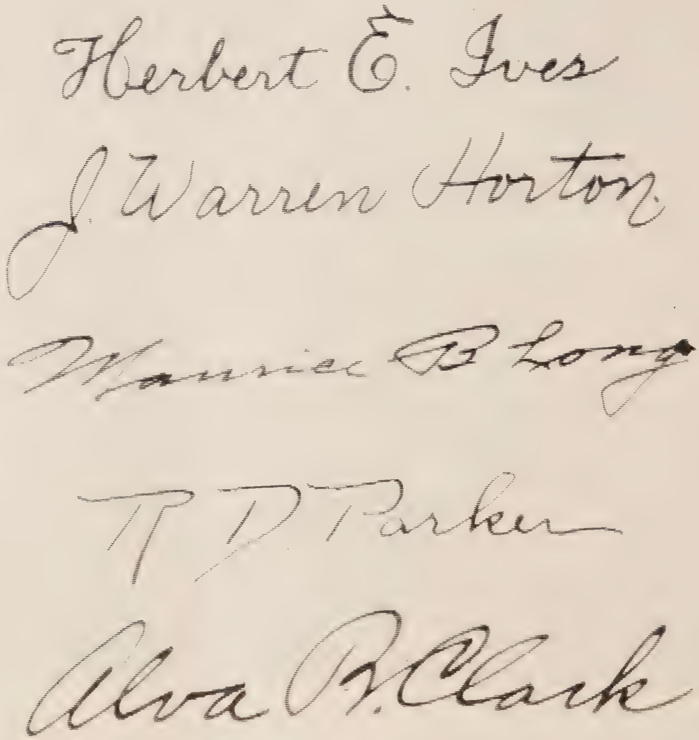


Fig 7. Transmission of Signatures.

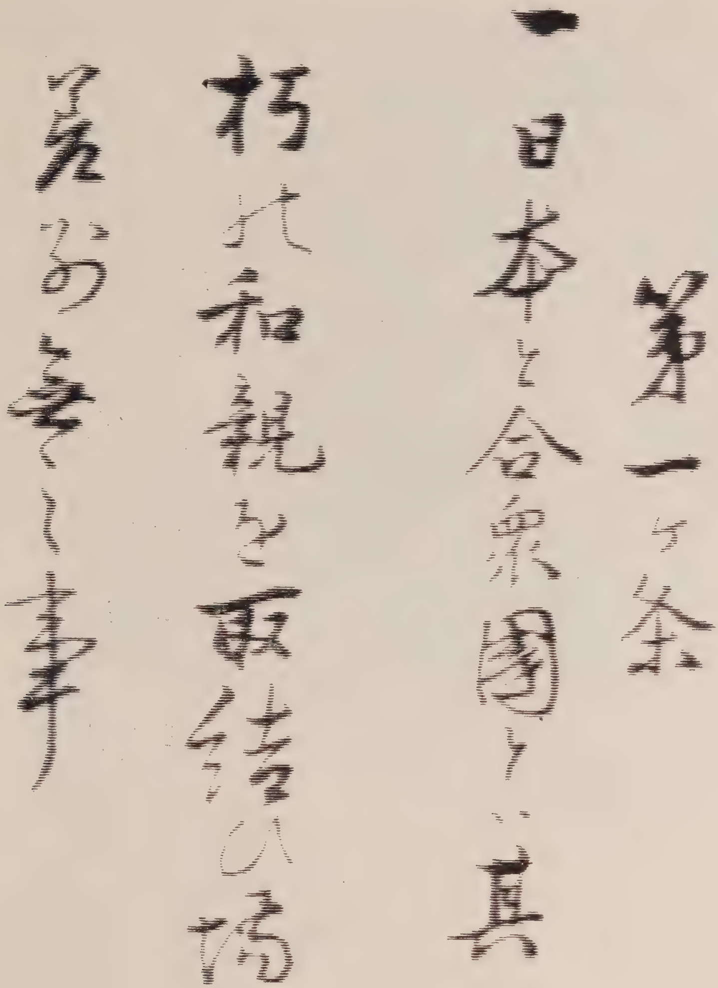


Fig. 8. Transmission of autograph material—Part of Japanese-American Treaty of 1853.

Cleveland and San Francisco and a picture transmission service has been established between these points. In March, 1925, pictures of the inauguration of President Coolidge were transmitted from Washington simultaneously to New York, Chicago and San Francisco and appeared in the afternoon papers in all three cities.

We are indebted for this information on developments in picture transmission to the Bell Telephone Laboratories, Incorporated, and to Mr. W. C. Adams, Chief Engineer of the Northern Electric Co., Montreal, for supplying the original photographs with permission for us to use them to illustrate this description. More detailed information on this

Fig. 9. Transmission of finger print.

subject will be found in Reprint B-122-1, May, 1925, of the Bell Telephone Laboratories, Inc. under the subject, "Transmission of Pictures over Telephone Lines", by Messrs. Ives, Horton, Parker and Clarke. This pamphlet may be obtained from the American Telephone and Telegraph Co., 195 Broadway, New York.

Effect and Extent of Recent Sleet Storm on Niagara System Lines

SINCE the memorable sleet storms of February and March, 1922, the Niagara System has experienced no sleet storms approaching in severity that of the storm of March 31st last. Rain driven by an east wind, varying from 30 to 45 miles per hour was general over the entire system and at such points where the temperature was at the critical point for sleet formation the rain attached itself to the conductors in the form of ice; building up to such an extent as to cause failure of numerous supporting structures. The most severe damage occurred on the low tension feeders running in a northerly southerly direction due to the increased conductor exposure to the strong east winds.

The 110 kv. lines withstood the strain exceedingly well, fully justifying a number of minor changes which we made following the experiences gained during the storms of 1922. Short interruptions to a few of the 110 kv. stations took place but, on the whole, the 110 kv. service was practically unaffected.

The districts of Essex, Kent and Niagara were unaffected since the temperature was sufficiently high to prevent the rain freezing on the lines; the Sarnia district similarly escaped due to the precipitation being mostly in the form of snow. St. Thomas and London districts experienced some sleet but not sufficiently extensive to cause much damage. St. Mary's and Woodstock, although in the sleet area, escaped with minor damages, while the lines to the west and north of Stratford, except in close proximity to the Stratford Station, were unaffected. Kitchener, Preston, Guelph, Brant, Dundas, Cooksville, York and Toronto districts experienced ice conditions to a more or less extent, resulting in considerable damage to low tension feeders in all the above districts with the exception of Dundas.

Early in the day, telephone communication over the Commission's private lines failed and, since the Bell Telephone Company lines and the Telegraph lines to most points were in a similar condition, we were forced to rely on our wireless systems to carry on the operation and to organize and direct repair crews. Communication was maintained between the Davenport Station, Toronto, Burlington and Niagara Falls by means of the high powered wireless and the operators at the various high tension stations were more or less in touch with each other over the guided wave sets during the afternoon of March 31st and continued to operate a portion of the system by this means for some three days until the physical telephone circuits had been repaired and placed in service.

Radio Verus Sleet

ON the morning of March 31 last, a severe sleet storm loaded the lines of the Niagara System with ice, and completely interrupted telephone communication between all transformer stations east of London.

It was in preparation for such an emergency, however, that the Commission had installed radio telephone transmitting and receiving equipment in all of these transformer stations. *1. These sets consist of very low power transmitters (Fig. 1) having an output of about 5 watts, with receivers having only one stage of amplification (Fig. 2). The aerials at the majority of the stations are single conductors run through the towers and placed in close proximity to the power conductors in order to use these conductors to guide the radio energy from one station to the next.

This emergency radio system was supplemented by a chain of broad-

*1. "Emergency Communication by Guided Radio Telephone"—Hydro Bulletin, June 1923, Page 183.

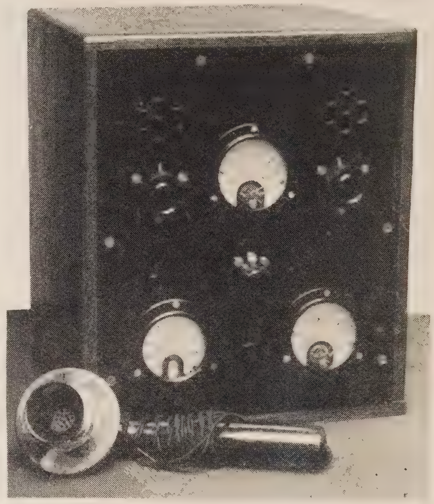


Fig. 1. Low Power Radio Transmitter.

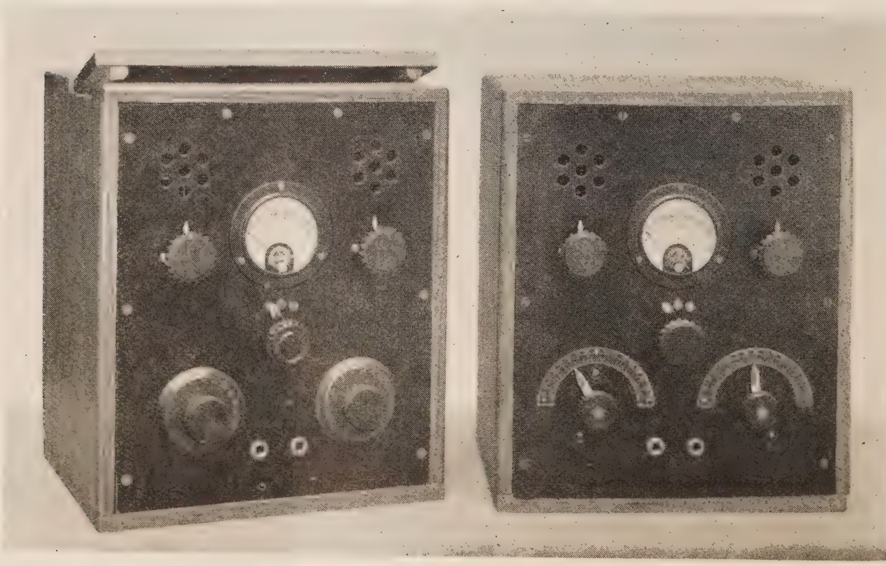


Fig. 2. Standard Radio Receivers—Niagara System.

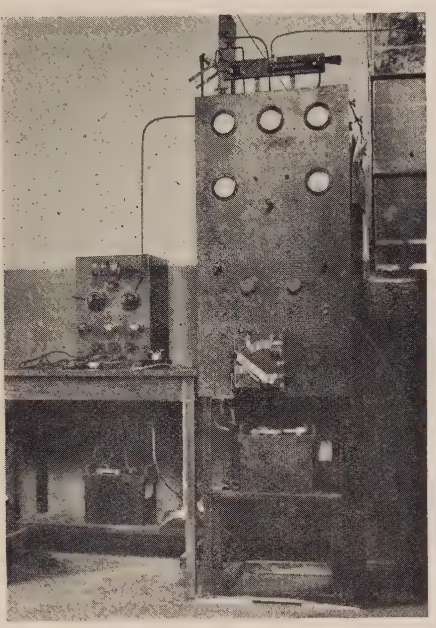


Fig. 3. High Power Radio Transmitter and Receiver Installation.

casting stations *2 (Figs. 3 and 4) located at the most important transformer stations and capable of operating with each other directly, to insure communication even in the event of a power line falling to ground and preventing the smaller sets from functioning on any section of the power system.

In this recent emergency, seventeen of these radio stations were called into service, and the Niagara systems were operated by means of these sets for a period of three days.

While the sleet was forming on the high tension insulators, static disturbances were very bad making operation of the radio equipment extremely difficult, and in some cases

*2. "Emergency Communication by Radio Telephone Broadcasting"—Hydro Bulletin, April 1925, Pag6 139.

Fig 4. Aerial at Dundas Station

impossible, but as soon as the sleet stopped forming and began to melt, this interference subsided and the radio equipment throughout the affected area served for transmission of all operating and other instructions and of system reports.

If the radio equipment had not been available in this emergency, the operation of the system would have been very slow and the power interruptions to the municipalities would have been of longer duration and much more serious.

This is, perhaps, the first instance where so many radio stations have been used in a practical manner to give service when a telephone system has failed. In this case all of the radio equipment was operated by the regular station operators on pre-arranged schedules, and proved quite equal to the emergency.

Hydro Electric Power Progress in Canada During 1925

(Extracts from Bulletin No. 931 of the Dominion Water Power and Reclamation Service, Department of the Interior, Ottawa.)

HYDRO-ELECTRIC and water power development in Canada reached record proportions during the year 1925, the increase in the total installation far exceeding that of any previous year. This is indicated by the review of the year's activities prepared by the Dominion Water Power and Reclamation Service of the Department of the Interior, whose records show that 719,000 h.p. was added during the year bringing the total installation in the Dominion to 4,290,000 h.p. Many projects are also under way which will add more than 250,000 h.p. in the early part of 1926.

Not only was 1925 of outstanding interest on account of the large increase in installed capacity, but it marked the bringing into operation or completion of a number of large projects which have been under active construction for the past few years. Of these the most notable are the Queenston development of the Ontario Hydro-Electric Power Commission on the Niagara River with 500,000 h.p. completely installed, and the development of the Duke-Price Power Company on the Saguenay River in Quebec which brought into operation 360,000 h.p. of an ultimate capacity of 540,000 h.p. While the next year or two are not expected to witness as large increases as 1925 there are projects of great magnitude now under way or in early prospect which will provide substantial additions as they are brought into operation. These include the 800,000 h.p. development recently commenced at Chute a Caron on the Saguenay River by the Aluminum corporation of Canada and a project of almost the same ultimate proportions on the Bridge River in B.C. by the British Columbia Electric Railway Com-

pany. Numerous other developments of lesser capacity have either been commenced or are in early prospect so that there is every assurance that the average growth of the past few years will be well maintained in the future.

The widespread nature of the 1925 activities is disclosed in the following paragraphs which outline the developments by provinces. Quebec led with a total installation of 438,300 h.p. largely contributed by the development of the Duke-Price Power Company. Ontario followed with almost 200,000 h.p. contributed chiefly by the Queenston development of the Ontario Hydro-Electric Power Commission. Other provinces having important additions were British Columbia with 58,984 h.p. and Manitoba with 21,900 h.p.

British Columbia.

The 58,984 h.p. net addition to British Columbia's total during 1925, was contributed by two developments, the Stave Falls plant of the British Columbia Electric Railway Company and the Lower Bonnington Falls plant of the West Kootenay Light & Power Company.

At Stave Falls on the Stave River the British Columbia Electric Railway Company brought to completion work begun in 1922 which involved the trebling of the storage capacity in Stave Lake both by the raising of the lake level 22 feet by new dam construction and by diverting the waters of Alouette Lake to Stave Lake by the construction of a tunnel. Due to the increase in head and the additional water supply a fifth unit of 15,000 h.p. was added during 1925 to the plant and the other four units raised to the same capacity necessitating the rewinding of the existing generators. The net increase in capacity amounted to 23,000 h.p.

Good progress was made by the same Company in the work under way at Alouette Lake. The dam at the outlet of the lake and the tunnel 3,550 feet long leading the waters to Stave Lake were completed during the year. It is expected that the power station at the Stave Lake end of the tunnel, with an installation of 12,500 h.p. will be completed during 1926.

At Lower Bonnington Falls on the Kootenay River the West Kootenay Light & Power Company replaced its old plant of 4,016 h.p. with an entirely new development. Two units of 20,000 h.p. each were brought into operation on July 1, 1925, and a third unit of similar capacity will be added during 1926. The Company is also re-winding two of the generators in its Upper Bonnington Falls plant to secure increased power capacity.

The Powell River Company completed the raising of its storage dam on Powell River during the early part of the year and work is in progress on the construction of a 14 foot diameter penstock which will supply three new units of a total capacity of 25,860 h.p. These units it is anticipated will be in operation early in 1926.

Manitoba.

The increase of 21,900 h.p. in Manitoba's total during 1925 was

entirely in the Point du Bois plant of the City of Winnipeg on the Winnipeg River. Three units of 7,300 h.p. were added during the year and contracts were awarded for two further units of the same capacity for delivery in 1926. These last units will bring the Point du Bois plant to its full capacity of approximately 104,000 h.p.

Ontario.

The total increase in the Ontario installation was 199,750 h.p. during 1925. While this was chiefly accounted for by developments of the Ontario Hydro-Electric Power Commission, there were other developments by private organizations of notable importance.

The Ontario Hydro-Electric Power Commission added two units of 55,000 h.p. each to its Queenston plant on the Niagara River thus bringing this, the largest completed development in the Dominion, to a capacity of nine units and 500,000 h.p. with the possibility of the addition, later, of a tenth unit. In the western part of the province the Commission added two units of 12,500 h.p. to its Cameron Falls Plant on the Nipigon River thus bringing this development to its full capacity of 75,000 h.p. For the benefit of the same plant a dam at Virgin Falls was completed which will provide for complete regulation of the discharge from Lake Nipigon.

In the Georgian Bay system the Commission completed the re-construction of the South Falls plant on the South Muskoka River increasing its capacity by 3,750 h.p. A short distance above South Falls a new plant of 1,800 h.p. capacity is being constructed at Hanna Chute. This is expected to be ready for operation about March, 1926. For the further supply of this territory detailed field investigations were made of the power possibilities on the Musquash or Lower Muskoka River.

For the supply of the Central Ontario System a new development of 4,800 h.p. capacity was completed during the month of May, at Dam 9 on the Trent Canal below Campbellford, this plant being operated by remote control from the Ranney Falls station a few miles distant.

The Commission also continued its investigations of further sources of power on other rivers of the province, notably the possibilities on the Ottawa and St. Lawrence Rivers.

Among the activities of private organizations, the Abitibi Power & Paper Company acquired the 24,000 h.p. development at Island Falls on the Abitibi River from the Hollinger Consolidated Gold Mines and added 24,000 h.p. to its capacity during the year, the power being transmitted to the Company's mills at Iroquois Falls. The same company added a 6,000 h.p. unit to its development at Twin Falls on the Upper Abitibi River.

In the extreme westerly part of the province, the Keewatin Power Company substantially completed the construction of a 17,000 h.p. development at the Western Outlet of the Lake of the Woods, at the same time improving the discharge capacity of the Western Outlet and

re-constructing the Norman Dam. The power thus provided will be used by the pulp and paper mills at Kenora.

In the Sudbury district the Wahnapitae Power Company completed a new development of 7,000 h.p. on the Wanapitei River. On Manitoulin Island a new plant of 1,750 h.p. capacity was built on the Kagawong River for the Manitoulin Pulp Company.

Two developments are under construction by the Quinte and Trent Valley Power Company which it is expected will be completed early in 1926. The first is at Campbellford on the Trent River where 1,100 h.p. is being installed and the second at Frankford on the same river with an installation of 2,980 h.p.

Quebec.

As has already been stated 1925 was a record year in water power development in Quebec province with new installations totalling to 439,000 h.p. This increase was largely accounted for by the bringing into operation of the Isle Maligne development of the Duke-Price Power Company on the Saguenay River with an initial installation of 360,000 h.p. Work is proceeding on the extension of the plant which it is expected will raise the total to 480,000 h.p. by February, 1926. The energy from this development is to be supplied to various pulp and paper mills of the district and temporarily to the proposed reduction plant of the Aluminum Corporation of Canada.

In the Eastern Townships the Southern Canada Power Company completed the installation of a 37,800 h.p. plant at Hemming Falls on the St. Francois River while the 12,000 h.p. extension of the Company's Drummondville plant on the same river is expected to be ready before the close of the year. Both these developments supply the Company's extensive transmission system located in this industrial portion of the province, additional lines having also been completed during the year.

In the southwestern part of the province the Ottawa River Power Company brought into operation its plant at Bryson on the Ottawa River with an initial installation of 25,000 h.p. the ultimate designed capacity being 75,000 h.p. The energy is transmitted to Ottawa, Hull and district.

The Chicoutimi Electric Company's 3,500 h.p. plant at Garneau Fall on the Chicoutimi River was also placed in operation during the past summer.

Two other hydro-electric undertakings are well advanced and are expected to be placed in operation in the near future. The largest of these is the Shawinigan Water and Power Company plant on the Batiscan River at St. Narcisse, which will probably be completed by July, 1926. The plant is to have an initial installation of 22,800 h.p. and an ultimate capacity of 45,600 h.p. in units of 11,400 h.p. each and will be used to supply additional energy to the Company's system.

North of Ottawa, the Gatineau River Power Company expects to complete the extension of its plant

on the Gatineau River near Maniwaki by February, 1926. The plant will have an installation of 2,500 h.p. with provision for an ultimate 3,730 h.p. to supply a transmission system extending to Gracefield.

Of construction recently started, the largest power project of the province, has been commenced at Chute a Caron on the Saguenay River. This has been undertaken by the Aluminum Corporation of Canada to supply its new reduction works and an installation of some 800,000 h.p. has been proposed in this connection.

The excellent work of the Quebec Streams Commission has continued to greatly benefit and encourage the development of water power in the province. In addition to the operation on extensive storage reservoirs on the St. Maurice, St. Francois and Ste. Anne de Beaupre Rivers, the Commission completed and brought into operation two additional reservoirs of importance and pursued extensive surveys and studies of further storage projects and power sites. The Kenogami Lake reservoir controlled by the Taschereau dam was completed and the full storage of 13 billion cubic feet is being utilized to regulate the Sables and Chicoutimi Rivers. The Metis reservoir of 2¾ billion cubic feet capacity was also completed and is being operated to regulate the flow of the river of the same name. Storage reservoir surveys and studies by the Commission include Lakes Baskatong and Kabonga on the Upper Gatineau, a detail survey of Mekinac Lake project on the St. Maurice, surveys of Tremblant Lake on a lower tributary of Rouge River and of Morin Lake on Fourchue River, an upper tributary of du Loup River, Temiscouata County. The Commission also carried out a survey of possible power sites in the Upper Ottawa basin up to Lake Victoria and has under study a proposed dam and flood prevention work on Bras River tributary of Gouffre River at Baie St. Paul.

"Hidden Dangers"

IN a recent number of the *Electrical Review* there is an editorial on this subject which is of some interest. This editorial is extracted in the following, giving those portions that we believe may be of most interest to our readers.

"The idea that electricity in some form or other may be applied to the body with beneficial results has possessed the layman ever since that mysterious agency has been available to his hand; and the temptation to apply such treatment to himself, without the advice of a medical man, has frequently been too powerful for him to resist—with fatal results in some cases. A notable instance of this tendency was the popularity of the "Harness belt" some 30 years ago, a device which was shown by this journal at the cost of a series of hard-fought libel actions to be electrically useless;

the vendors of the belt had reaped a rich harvest from the simple folk who put their faith in the marvellous healing properties claimed for the belts, which professed to contain electric batteries of the "Voltaic pile" type, but were often not completely connected up to form an electric circuit, and in any case had no curative value at all, such benefits as the wearers experienced being due not to electricity, but to faith and flannel.

"The Harness belt, however, was at least harmless, except to the pocket of the purchaser (though many poor wretches whose lives might have been saved by proper medical attention were deluded to their destruction by specious promises of betterment), the same cannot be said of some of the powerful and effective instruments that are now available to the public. That electricity in therapeutics has proved itself of immense value in a variety of ways is, of course, beyond question; but we wish to emphasize the fact that such treatment should never be undertaken except under competent medical supervision.

"Experimenting with X-rays has entailed painful consequences to many an amateur, and apart from the danger of X-ray burns which may result in the loss of limbs and eventually of life, there are strong reasons for restricting the use of this very potent radiation to the hands of experts worthy of that trust. That a word of warning is not superfluous may be gathered from recent correspondence in the lay Press regarding the use of X-rays in shoe shops, for the purpose of revealing to customers the disposition of the bones of their feet when correctly fitted with suitable footwear. The intention is good, but the operation is unnecessary; and although the makers claim that the apparatus is so designed as to safeguard against any harmful effects to either the customer or the operator, the fact remains that the element of danger is present, particularly to the latter, who is constantly exposed to the effect of any stray radiation that may occur. Such effects are cumulative, and may not be revealed for many years after the mischief has been done. Nor is it at all certain that all the dangers associated with X-rays have yet been identified.

"In our last issue Dr. W. S. Hedley outlined the history of the use of X-rays in therapeutics, and described the elaborate precautions that had been adopted to guard against the dangers surrounding the X-ray tube—in spite of which from time to time we still have to record another martyrdom; and he gravely questioned whether every medical man who handled these rays in a professional capacity, was fully conversant with their properties and their attendant risks. In his opinion no one but a qualified man should apply the X-rays to the living body.

"Again, according to the WEEKLY DISPATCH, only last week a man who was in the habit of treating himself with "artificial sunlight" fell asleep in the act, and was exposed to the radiation, presumably containing ultra-violet rays, for an hour and a half; he woke up to find that his skin had peeled off, and has been seriously ill ever since the mis-

hap. Many people treat themselves in this way, and are liable to similar consequences. It is indeed fortunate that radium is too expensive to become the plaything of hypochondriacs—its unsuspected capacity for burning the skin was the cause of some serious occurrences in the early days, when a man would innocently carry a tube containing it in his waistcoat pocket."

In addition to the foregoing a case has been brought to the attention of the Bulletin which would have proved very serious had it not been detected early. In preparing her house for the reception of company, the mother of a year old baby moved a radio battery to another room so as to be out of the way, and placed it under the child's cot. Later in the day the child was placed in the cot for its afternoon rest, who upon waking began jumping around in its bed. This action forced the wire springs supporting the mattress against the terminals of the battery with the result that the bedding took fire. Fortunately the mother was close at hand and was able to prevent what might have been a very serious accident.

Speaking of Courtesy

A CERTAIN author whose name escapes us, writing of courtesy, once said: "With your hat in your hand you may travel the land," or words with that meaning.

We think this writer confused courtesy with servility, and the picture he draws appeals to us as more representative of the obsequiousness of an old-rags-and-bottles-man than of the type of politeness that earns friends and respect by the same action.

Still, it is difficult to exaggerate the need for and profit in courtesy, more particularly, inherent courtesy in the little, apparently insignificant, obscure things and contacts; almost anyone has brains and acquired gentleness in sufficient degree to be considerate in obvious ways that would otherwise loudly proclaim him a boor.

We believe nothing has more dangerous potentiality for arousing irritation and generating bad-will than the manner in which a customer is dunned for an overdue account. Wondering if there are some electric service executives who have not given that thought sufficient attention, we abstract here a few paragraphs from a recent issue of the company organ of The Rochester (N.Y.) Gas & Electric Corporation:

"Perhaps it is not the most pleasant thing in the world to be reminded that one's gas or electric bill is unpaid and overdue, but sometimes bills and statements go astray or are mislaid and notification of the fact may be considered a courtesy. At least it was so construed by one customer recently, whose reply to a formal notification of an unpaid account is rather unusual:

"Gentlemen: I thank you for reminding me of my overdue bill. It got tucked away in my desk, out of sight, out of mind. I greatly appreciate the courteous tone of the notification, differing so greatly from the threats which were in vogue a few years ago. I enclose a check for the amount."

"This unusual reply came to the attention of Mr. Russell, whose letter asking permission to use it follows below. It is a pleasant thought to reflect that a busy executive was not too busy to appreciate and commend a casual though unusual letter.

"Dear Madam: Your letter is most unusual. In my long experience in public utility operation I do not recall that I ever before have had anyone thanking us for calling their attention to an overdue bill and at the same time commending the character of the notice which had been sent them.

"It is true, we have given considerable thought to this notice and have tried to make it as inoffensive as possible, at the same time complying with the law under which we operate. I suppose this particular notice has been changed at least a half dozen times in the last few years.

"I thank you sincerely for your letter and I would like to ask the privilege of publishing it in our magazine, as it stresses indirectly the importance of courtesy in all of our written communications to our customers, and the letter will be of considerable assistance to me in maintaining the type of service which we are trying to give to the people of Rochester. Very truly yours, Herman Russell, Vice-President and General Manager."

"Each of the above letters indicates that courtesy in the business world is not yet so prevalent as to have become entirely common-place, that it does pay dividends, and that it has ample room for expressing itself in written or printed communications as well as in personal contact."

Perhaps these comments and letters will cause inquiry as to how your company is wording its unpaid account notifications! No doubt in many companies the courtesy element in these notices can be strengthened, and the 'pulling power' increased in proportion to the reduction in the degree of irritation they arouse.

—*Electric Light and Power.*

"This Little Pig Stayed at Home......"

"Some little pigs go to market,
But I have a living to earn;
They turn into pork chops and
sausage,
While I turn an old treadmill churn."

Life is just a greasy grind to some pigs—and in other ways besides passing through a sausage machine.

It's just one thing after another. Sometimes, as in the case of the Baconian philosopher shown in the illustration, it's slat after slat of a treadmill, and whack after whack on the back to stir an ambition that never gets a pig anywhere.

This particular pig lived—and labored—in one of the best farming

regions of New York. Possibly he still lives and labors.

He seems to have had progressive ideas—to have been, in fact, more progressive than his surroundings and the power plant methods in vogue there. He was discovered by the General Electric Company when gathering material for a farm motion picture, and plays his part in the forthcoming film.

He was a real pig, lived on a real farm and really operated the treadmill and the churn.

In view of the very general interest the electrical industry is taking in farm operations and methods, this power plant and its application will, on examination, be found of interest if not of value. It is obviously a 1 h.p. (hog-power) machine; while it has, of course, an r.p.m. rating, its g.p.m. (grunts per minute) are more indicative of its speed.

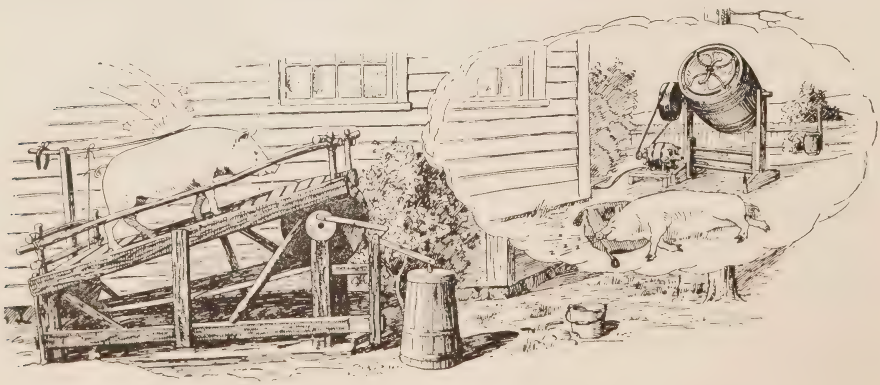
Although the apparatus is mechanical rather than electrical, it has some electrical features. For example, it is equipped with a switch, apparently of the disconnecting type, for the purpose of providing automatic acceleration and remote control. Each revolution of a wheel belted to the tread breaks the horse-shoe magnet switch. This causes the blade of the switch (beech or birch) to make a forcible contact with the posterior of the motor, which is covered with raw hide—very raw, presumably, after the apparatus has been operating for some time.

Engineers who have examined the photograph have concluded that, although the motor is lubricated by lard, it is probably somewhat noisy in operation, its hum rising at times to the pitch of a squeal.

Both the switch and dash of the churn are operated on the a-c. principle. No transformer is employed, the motor stepping itself down when the work is finished.

The device is, of course, a labor-saver for all except the pig. The effect on the pork market, however, is quite another question. Its logical result would be to make the spare ribs sparer.

At all events, electricity is coming to the aid of those who toil at manual labor—pigs as well as others. And even if "pigs is pigs", it will be a glad day for any of them who have lived this treadmill existence when the electric motor displaces the last pig-driven churn. — *The Synchronizer.*



HYDRO NEWS ITEMS

Central Ontario System

The City of Peterboro has been making some important changes in its street lighting system. The Multiple system in the East City has been entirely reconstructed and brackets with radial wave reflectors installed. Where the trees interfere, the suspended type of fixture with a holophane shade has been found to be very effective. In the business part of the city, the incandescent lamp is gradually replacing the old series magnetite arc, owing to the high cost of maintenance on the latter type.

* * * *

The Port Hope Sanitary Company has been making some interesting experiments in the operation of the electric oven for enamel ware. Owing to the large type of furnace used and the high temperature required, special arrangements have been necessary.

* * * *

A team picked from the Commission's employees in the power houses on the Trent River entered the local hockey league and after an uphill fight carried off championship honours.

* * * *

Georgian Bay System

Work is proceeding on the construction of a new grain elevator at Midland, which will have an initial capacity of two million bushels. The contract calls for completion early in October and it is proposed to meet the power requirements by means of a 22,000 volt extension from the 4th Street substation in Midland, and the erection of a step down station on the consumer's premises of 1,500 kv-a. capacity.

* * * *

Preliminary estimates have been completed and approval granted for rural extensions totalling approximately 21 miles around Sparrow Lake, in the north end of Georgina Township, and in the north end of Innisfil Township with service to a total of approximately 110 consumers. Work instructions have already been issued and it is expected that the lines will be completed and placed in service early in the summer.

* * * *

Niagara System

Arrangements are being made for the construction of a second double circuit wood pole line from Essex H.T. Station to Windsor No. 2 substation. This line will be a duplicate of the line built in 1925, and will be constructed with suspension insulators and 500,000 circular mill aluminum conductor.

* * * *

A field office has recently been established in Sarnia in connection

with the operation of the Sarnia Rural Power District. The summer cottage load in this district is growing very rapidly along the St. Clair River and the southern shore of Lake Huron.

* * * *

A Rural Power District office is being established at Brantford to take care of rural lines in that district.

* * * *

It is estimated that at least 500 miles of primary lines will be constructed in the rural section of the Niagara district during the year 1926—320 miles having been already signed up. The capital cost of rural lines to be constructed in the year 1926, in the Niagara System, will amount to approximately $1,000,000.00.

* * * *

St. Lawence System

The Police Village of Russell Commenced taking power on February 17th, with 102 lighting consumers connected.

* * * *

Residents of the Hamlet of Morewood, Winchester Township, are receiving service from the Chesterville-Russell 4,000 v. line.

* * * *

The Police Village of Avonmore is negotiating for rural service in the Apple Hill Rural Power District in conjunction with residents of Monkland and rural residents between Apple Hill and Avonmore.

Association of Municipal Electrical Utilities

Minutes of Meeting of Executive Committee

A meeting of the Executive Committee was held at the office of the Hydro-Electric Power Commission on Friday, April 16, 1926, at 2.15 p.m. The following members were present: Messrs. R. H. Starr, President, J. J. Heeg, C. T. Barnes, E. J. Stapleton, R. J. Smith, J. G. Archibald, O. H. Scott, J. E. B. Phelps, V. S. McIntyre, T. W. Brackinreid, T. J. Hannigan, G. J. Mickler, and S. R. A. Clement, Secretary.

This meeting was called for the purpose of considering plans for the Summer Convention of the Association.

Moved by Mr. O. H. Scott.
Seconded by Mr. V. S. McIntyre.

THAT the minutes of the previous meeting of the Executive Committee be taken as read.

CARRIED.

Mr. W. R. Catton, Chairman of the Papers Committee being absent on account of illness, the Secretary read a report from him suggesting papers to be given at the Convention.

Mr. J. J. Heeg, Chairman of the Convention Committee presented a report from that Committee sug-

gesting locations and dates for the proposed Convention.

Mr. Jas. G. Reid, Manager of the Bigwin Inn, Lake-of-Bays, being present addressed the meeting, outlining the accommodation he was prepared to offer should the Association decide to hold its Convention there.

Mr. Gadsby representing the Canadian National Railways, also spoke outlining conditions under which transportation facilities could be arranged.

Moved by Mr. O. H. Scott.
Seconded by Mr. E. J. Stapleton.

THAT the Summer Convention of this Association be held at the Bigwin Inn, Lake-of-Bays, on June 24th and 25th.

CARRIED.

Moved by Mr. J. E. B. Phelps.
Seconded by Mr. Brackinreid.

THAT the programme of the Convention be as follows:

Thursday, June 24th, Afternoon—

Paper on "Lightning", by F. W. Peek, General Electric Co. Schenectady, N.Y.

Paper on "Voltage Variation on appliance loads", by J. W. Peart, Public Utilities Commission, London, Ont.

* * * *

Friday, June 25th, Morning—

Address by Mr. Sinclair on "The Workman's Compensation Board".

An address to be obtained by Mr. Hannigan on the "Chicago Water Diversion".

Afternoon—

Paper on "Merchandising" to be obtained by Mr. Mickler.

Paper by Mr. P. B. Yates, "Comparative operating expenses".

CARRIED.

Mr. G. J. Mickler, and Mr. V. S. McIntyre reported on behalf of the Merchandising Committee that the Committee had had a very successful meeting that morning and would have a report to present at the Convention.

Mr. J. G. Archibald, Chairman of the Rates Committee reported progress but could not make definite statements at this time.

Mr. V. S. McIntyre advised as to work done concerning the Pension Scheme for the Municipal Utilities, stating there would be a report presented at the Convention.

The Secretary reported as to membership, drawing attention to those Utilities that had failed to renew membership for this year, and asking the district directors who constitute the Membership Committee to take action in an endeavor to have these Utilities forward their dues.

Moved by Mr. V. S. McIntyre.
Seconded by Mr. R. J. Smith.

THAT the Secretary and Treasurer be each paid an honorarium, of an amount the same as paid last year.

CARRIED.

On motion of Mr. R. J. Smith, seconded by Mr. C. T. Barnes, the meeting adjourned at 4.10 o'clock.

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in March, 1926.

Appliances

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, King & Simcoe Sts., Toronto.

Polyphase Motors, Type FTR.

* * * *

CASSIDY'S LIMITED (Submittor), 47-55 St. Paul St. W., Montreal, Que.

SUPERIOR ELECTRICS LIMITED, (Mfr.), Pembroke, Ont.

Electric Toaster "Cassidy's Special".

Electric Pressing Iron "The Canada Special" and "Cassidy's Special".

* * * *

DRYSDALE ENGINEERING COMPANY LIMITED, Montreal, Que.

Motor-operated Blowers "Deco System".

Marking: Transfer and rating on motor nameplate.

* * * *

FEDERAL MACHINE AND WELDER COMPANY, Dana Avenue, Warren, Ohio.

"Federal" electric spot welding machines. Junior Type and Heavy Duty Type.

* * * *

GOULD STORAGE BATTERY CO., INC., 250 Park Avenue, New York, N.Y.

Radio Appliances—"A" Power Supply. "Gould Unipower".

* * * *

LANDERS FRARY & CLARK, New Britain, Conn.

"Universal" Cooking and Liquid Heating Appliances, portable type. (As listed on Laboratory Approval Card, dated December 8, 1925.)

"Universal" Curling Irons, Cat. Nos. 9201, 9801, 9802, 92011, 98011, 98021; Glue pots, Cat. Nos. 957, 958, 952, 953; Soldering Irons, 9130-9133 Incl.; Flat Irons, Cat. Nos. 909, 9191, 9070 and 9035.

* * * *

MUELLER LIMITED, Sarnia, Ont.

"Mueller" motor-operated pumps and water systems.

* * * *

PACKARD ELECTRIC CO., LIMITED, St. Catharines, Ont.

"Packard" Lighting Transformers.

Marking: Nameplate with rating.

* * * *

*FANSTEEL PRODUCTS CO., INC., North Chicago, Ill.

Rectifiers (as listed on Underwriters' Laboratories card, dated December 8, 1925).

Radio Appliances (as listed on Underwriters' Laboratories card, dated October 2, 1925).

Marking: Nameplate with trademark "Balkite" and rating.

* * * *

*KIRKMAN ENGINEERING CORP., 484-90 Broome St., New York, N.Y.

Radio Lightning Arrester.

Marking: Manufacturer's trademark moulded on base.

* * * *

*MEADOWS MFG. CO., The, Bloomington, Ill.

Portable, motor-driven washing machines, Greyhound and Meadow Lark, Master, Laundrola, Super-Laundrola.

Marking: Nameplates with manufacturer's name and trade name and motor rating.

* * * *

*MUTER CO. LESLIE F., 76th and Greenwood Ave., Chicago, Ill.

"Muter", "Guardian" and "Security" Radio Lightning Arrester.

Marking: Trade name molded in porcelain.

* * * *

Portable Lighting Devices

THE HANDEL COMPANY, Meriden, Conn.

Portable Electric Lamps, "Handel".

* * * *

Fittings

OSBORNE ELECTRIC CO., 32 Temperance St., Toronto, Ont.

Overload Alarm, Type B, 2 to 5 A.

* * * *

THERMO ELECTRIC CO., LIMITED. Morrell St., Brantford, Ont.

Cast-iron conduit fittings, Types A, B, C, E, G, H, J, K, LB, LL, LR, T.

Service Entrance Fittings, Types F and FE.

* * * *

*ALL-STEEL-EQUIP CO., Aurora, Ill.

Outlet Boxes and Plates (as listed on Undewriters' Laboratories card dated June 5, 1925).

* * * *

*THOMAS & BETTS CO., The, 63 Vesey St., New York, N.Y.

Bushings. Malleable Iron.

Chase couplings and nipples for ½ and ¾ in. conduit.

Bushings. Cast-iron outlet fittings. "Motor Outlet", Cat. Nos. 1325-26.

Service entrance fittings. Cast-iron outlet fittings. "Entrance Cap" Cat. Nos. 1430-33 incl. Cast-iron conduit outlets, Cat. Nos. 1470-75 incl.

Floor outlet fittings. Malleable iron "Bulb Tees", ¾ in. to 1-¼ in. "Bushed Elbows", ¾ in. to 1-¼ in.; "Brass Floor Couplings, ¾ in. to 1-¾ in.

Malleable Iron Connectors, "T. & B. Squeeze", "Standard", Cat. Nos. 280, 1500, 1620, A-1. Helical Steel, Cat. No. 1267.

Marking: "T. & B.", except Cat. No. 1267 which has no marking.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE
BULLETIN

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International Electrotechnical Commission Visits Canada

A scientific event of unusual importance recently occurred in the United States. The first meeting of the International Electrotechnical Commission to be held in America took place in New York, April 12 to 22. Following the meeting the foreign delegates made a tour of the Eastern States and portions of Ontario and Quebec.

The International Electrotechnical Commission is an Association of electrical engineers from 25 different countries of the world, the object of which is to promote international standardization in electrical engineering. It deals with such questions as the rating of electrical machinery, prime movers, nomenclature, standard voltages, rules and regulations for electrical construction and any other related subjects. It was formed in 1906 and has established a central office in London, England. It has held annual conferences since then, except during the war period. At these conferences the opinions of the various national committees are discussed and the conferences endeavor to arrive at agreement among all countries with respect to the various points at issue.

At the meeting in New York, representatives from 18 countries were present, and notable progress was made towards uniformity of practice regarding the subjects under discussion. The sessions were extremely interesting in view of the cosmopolitan character of the conference. It was evident that there was an earnest desire on the part of the delegates to reach agreement whenever possible. The United States took a keen interest in the proceedings and was represented by a large delegation of leading electrical engineers. Canada was also represented by four delegates: Professor H. T. Barns and Mr. R. J. Durley,

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of Montreal; Mr. John Murphy, of the Department of Railways and Canals, Ottawa and Mr. W. P. Dobson, of the Commission's staff.

After the conference the delegates were the guests of the American and Canadian Committees on a tour which included Niagara Falls, Toronto, Ottawa and Montreal. Two days were spent at Niagara Falls visiting the power stations and other points of interest, as the guests of the Niagara Falls Power Company and the Hydro-Electric Power Commission. On April 29 a dinner was tendered the delegates by the Commission. Mr. Gaby was chairman at this function and welcomed the delegates on behalf of the Commission. Speeches were also made by the Mayor of Niagara Falls, Mr. Munro Grier, and several of the visiting delegates.

At Toronto, where they stayed only a few hours, they were entertained by the various electrical and engineering organizations. After a drive around the city, a dinner was held at Hart House at which Sir William Mulock presided. Addresses were given by Signor Semenza of Italy, President of the International Electrotechnical Commission, and also by representatives of Great Britain, Czechoslovakia and Switzerland.

At Ottawa and Montreal a similar entertainment was tendered the visitors. They were given official welcomes in each of these cities.

The meeting together of so many nationalities offered splendid opportunities for exchanging national ideas and undoubtedly did much to promote a better international understanding with regard to non-technical as well as technical matters. Perhaps no better description of the International Electrotechnical Commission could be given than that applied to it by the Electrical World in which it referred to the Commission as "An Electrical League of Nations."

Hydro Electric Service for Rural Districts as Supplied by the Hydro-Electric Power Commission

EVEN before the delivery of power to any of the Hydro served towns, there was an interest in the possibility of supplying electric service to rural districts as rural residents became familiar with Hydro principles by reason of surveying of routes for high tension lines and later, the building of these lines. The supplying of electric service to towns, cities and villages at cost, apparently appealed to the thrifty instincts of the rural resident. Later again, the actual turning on of power and the supplying of electric service in towns at favorable rates, accentuated the desire on the part of our "country cousins" to have such service supplied to them and applications for estimates of cost poured into the Commission from districts adjacent to towns, cities and villages that were being connected or being served.

Districts to be Served and Their Needs:

The Province of Ontario covers a very great area, approximately 400,000 square miles. Of this, the portion known as "Old Ontario" has an area of approximately 40,000 square miles, about 24,000,000 acres, of which about 15,000,000 acres is cleared and 10,000,000 acres arable land. The population according to the 1922 census, in the rural districts in this area—the Old Ontario portion, is given as 1,560,238, and that of the cities, towns and urban centres, 1,736,244.

In most of these rural districts the number of residents who are interested in progressive movements, do not by any means, include the whole population and it has been the experience of the Commission that in most districts it is difficult at the beginning, for those in the district anxious to get electric service, to secure the required number of three contracts per mile. There are always some who are interested in progressive movements and anxious to improve their condition of living as well as secure power for their needs.

The power and electric service requirements of residents in rural districts were surveyed in a cursory way, in about sixty districts in 1920

Dairy Farm, specializing in pure and wholesome milk, Hydro does it all.

but this survey did not include the listing of the present power equipment on farms. Such a survey in the United States indicated that the actual total uses of power in its various forms by rural residents, was equal to or greater than the total power requirements of the urban centres. It is, of course, not possible at present to apply electric power service to all the power requirements of the farm and rural districts as much of it is used for field work and transportation either on the premises or on the highway and therefore, the uses are confined for the present to lighting and domestic uses for the house, lighting and stationary power uses for the barn, and threshing and silo-filling by portable outfits known, so far, to the Hydro-Electric Power Commission, as "syndicate outfits".

Rural Electric Service as the Commission Classifies it:

In many of the countries distributing electric power in rural districts, the service given in towns, small cities and villages is included as a part of, and known as "rural service". The Commission classifies as "rural service", that electric supply which is delivered to farm areas and hamlets and police villages in those areas which are essentially a part of that rural district. The suburban areas adjacent to very large centres, have been taken care of under what is known as "the voted area scheme" whereby a section of the township may be set apart to take action in that specified way to secure power as a municipal unit or as a unit which for this purpose is entitled to have and handle its Hydro System on the same basis as a municipality, taking power en bloc and retailing it over its own distribution system to its consumers.

Rural Uses for Electric Power:

The possible uses to which electric service can be applied in rural districts in the household, are much the same as that in town, with the possible exception that the work of the farm housewife is more irksome as that in some families her duties besides housework, includes some assistance in the dairy; the houses in the country are much larger, as a rule, than those in town; the family is larger and the work for these reasons is heavier; in addition, the water is often supplied from a well as a source, and this requires the handling of weight and involves movement for a distance to and fro, in order to secure the supply. This condition, of course, can be relieved when there is electric service available to operate an automatic or storage water supply which will furnish a supply for household and other uses. By reason of the larger house and larger family, the possibilities of making good use of electric appliances are great.

The uses in the barn consist of lighting as of first and great importance, and power on most farms, for chopping, pulping of roots, pumping of water for barn service supply, for cutting straw and hay, cleaning grain, and on some, for mechanical milking. A number of other uses which, so far, have been developed only in a few places, new uses unheard of in this country are being tried in others and some of these

will undoubtedly be found useful for our farmers.

Threshing and silo-filling by a syndicate outfit has worked out very satisfactorily in quite a number of places. The power needs for this purpose are greater than for the average uses on a farm, therefore, the syndicate outfits which have been developed so far, include transformers as a part of the equipment for stepping down power to the motor voltage. The threshing machines and silo-filling outfits to which this syndicate equipment supplies power, are the standard large size that has been found in rural districts in the western part of the Province and it would seem highly desirable to encourage the use of the smaller outfits from the point of view of cheapening the electric service and bringing the size of this equipment within the capacity of the standard farm service transformer. In order to do this, a good deal of educational work is necessary, as the farmer seems to want to have a large outfit and have all the farmers he knows help do this kind of work by present methods. It seems to be a day for fore-gathering to enjoy community gossip and the interchange of ideas on subjects and topics of community, municipal and national interest.

There are a number of rural industries which are found in many districts, which can, and often do, take electric service, the creameries, butter factories, brick yards, tile yards, gravel-screening plant, stone-crushing plant, quarries, and a number of others. Where industries exist in rural districts it is highly desirable to have them as power users as it brings about in more complete resale benefits to all users by improving the load factor and results in lower costs to all of the users in the rural district.

Thr Distribution of Power to Rural Districts:

Prior to 1920, service was given in rural districts to petitioners—groups, on the basis of cost to the group petitioning, provision being made for the admission of others to the group. This worked out to the disadvantage of residents on the back lines of the rural district and to the advantage of the thickly populated areas adjacent to urban centres. There were sometimes many of these groups in the same township. All organizing movements and all transactions were made by dealing with the municipality, getting to the point of the ridiculous when we found four townships meeting in the centre of a police village. In 1920, this condition became so apparent that provision was made for correction of the same and distribution of power to rural districts, disregarding the municipal boundary lines as far as the district served, arranging, defining and recording the boundaries of the district, making it to fit the best economic condition whereby service could be given to those in the defined area, providing for transactions through the township governing body but arranging for operation by the Commission.

In 1921, the Provincial Government saw fit to provide a grant for bonusing Rural Power District lines. The Act passed at that time makes provision for bonusing to 50 per cent

of the cost of the primary line. In 1924, this was amended so as to include the secondary equipment and secondary lines, so that today the total cost of rural lines and secondaries are bonused by the Provincial Government to the extent of 50 per cent of their cost.

LEGISLATION:

Shortly after the turning on of Hydro Power in 1910, representatives of various rural districts adjacent to urban centres requested revision of Hydro Legislation so as to provide for distribution in rural districts. The Act was amended in 1911 so as to permit the supplying of power to groups who made application for such service. The Act was further amended in 1917, making provision for the setting apart a portion of the township as a unit to be supplied with Hydro-Electric Power on the same basis as are urban centres. Later, provision was made for supplying of power for street lighting in townships and in 1920, for distribution of power in rural power districts. Amendments were made from time to time, to make the Hydro Legislation meet the conditions which were imposed upon it by demands for improved service or other services required. The bonusing Act was passed in 1921.

CLASSIFICATION:

In the early days, distribution of power and electric service in rural districts was made on the basis of so many consumers per mile, the cost being apportioned to each evenly, regardless of the class of service they were taking. This was found to be unfair as the requirements of rural users were not uniform and therefore, in 1920, it was necessary to work out a classification in general, dividing the service into three groups, viz.—hamlet classes, small and medium farm classes and heavy farm classes. These exist today in the form set out below:

CLASS I—

Hamlet service includes service in hamlets where four or more customers are served from one transformer. This class excludes farmers and power users. Service is given under two sub-classes as follows:—

CLASS I-B—

Service to residences with more than six lighting outlets or twelve sockets, and stores. Use of appliances over 750 watts permanently installed, is not permitted under the class.

CLASS I-C—

Service to residences with electric range or permanently installed appliances greater than 750 watts. Special or Unusual loads will be treated specially.

CLASS II-A—

House Lighting—Includes all contracts where residences cannot be grouped as in Class I. This Class excludes farmers and power users.

CLASS II-B—

Small Farm Service—(Under 50 acres in area)—Includes lighting of farm buildings, power for miscellaneous small equipment, power for single phase motors, not to exceed 2 horsepower demand, or small electric range. Range and motors are not to be used simultaneously.

CLASS III—

Light Farm Service — Includes lighting of farm buildings, power for miscellaneous small equipment, power for single phase motors, not to exceed 3 horsepower demand, or electric range. Range and motors are not to be used simultaneously.

CLASS IV.—

Medium Single Phase Farm Service.—Includes lighting of farm buildings and power for miscellaneous small equipment, power for single phase motors, up to 5 horsepower demand, or electric range. Range and motor are not to be used simultaneously.

CLASS V.—

Medium 3 Phase Farm Service.—Includes lighting of farm buildings and power for miscellaneous small equipment, power for 3 phase motors, up to 5 horsepower demand, or electric range. Range and motor are not to be used simultaneously.

CLASS VI.-A—

Heavy Farm Service—Includes lighting of farm buildings and power for miscellaneous small equipment, power for single phase motors up to 5 horsepower demand, and electric range, or 10 horsepower single phase motor without electric range.

CLASS VI.-B—

Heavy Farm Service—Includes lighting of farm buildings and power for miscellaneous small equipment, power for three phase motors up to 5 horsepower demand, and electric range, or 10 horsepower, 3 phase motor without electric range.

CLASS VII.-A—

Special Farm Service—Includes lighting of farm buildings, power for miscellaneous small equipment, power for single phase motors from 10-20 horsepower demand, and electric range.

CLASS VII.-B—

Special Farm Service—Includes lighting of farm buildings, power for miscellaneous small equipment, power for 3 phase motors from 10-20 horsepower demand and electric range.

CLASS VIII.—

Syndicate Outfits—Includes any of the foregoing farm classes which may join in the use of a syndicate outfit, provided the summation of their relative class demand rating is equal to the kilowatt capacity of the syndicate outfit.

The classifying of services made it possible to apportion to each its share of the line. The secondary of the rural power district system is apportioned to each class of service on a unit basis and depends very materially on the grouping which can be made in hamlets and the district.

Below, is submitted a tabulation showing the line units that each class assumes, the class demand rating, average monthly kilowatt hour consumption and the estimated annual standard service charge, which at present applies in each new district:—

Class	Name	Line Units	Demand Rating Kv.	H.P.	Average Monthly Kw-hr.	Est. Annual Service Charge
I.	Hamlet Service (b)	1¼	¾	1	15	$ 19.44
	(c)	3	2	2⅔	150	35.64
IIA.	House Lighting	1¼	1	1⅓	15	24.30
IIB.	Light Farm Ser.	3	2	2⅔	35	37.26
III.	Light Farm Ser.	5	3	4	40	49.14
IV.	Medium Single Phase Farm Ser.	5	5	6⅔	70	51.30
V.	Medium 3 Phase Farm Service	5	5	6⅔	70	62.10
VIA.	Heavy Farm Ser. Single Phase	9	9	12	150	79.38
VIB.	Heavy Farm Ser. 3 Phase	9	9	12	150	89.64
VIIA.	Special Farm Ser.	15	15	20	300	117.72
VIIB.	Special Farm Ser. 3 Phase	15	15	20	300	142.56

NOTE: 16 Line Units required for a mile of loading.

Rates:—

At the end of each year, an analysis of the operation of each district system is worked out and rates adjusted for the coming year, based on the results obtained from the analysis.

The first kilowatt hour rate in rural districts is based on the cost of power to the district. The second or follow-up rate is one-half of the first, with a maximum of 2 cents similar to that for use in urban municipalities.

The following tabulations show the progress made in rural districts. —Table No. 1 shows the reduction in service charge by the application of the provincial grant towards the construction of rural lines; Table No. 2 shows the consumers under the various classifications by systems. Table No. 3 shows the capital expenditure, the number of consumers, the line mileage;

The sectional maps indicate where rural power districts have been created in the Province.

The Rural Primary Distribution Circuit

The standard circuit for distribution from the substation is 4-wire, 3-phase, 4,000/2,300-volt, star-connected, with the neutral wire grounded; the frequency is 25 or 60 cycles according to that of the generating system. One, or more if required, of these 3-phase circuits, is taken out of the substation and carried into the rural district.

The extent of the 3-phase circuit in any direction is determined by the amount of power to be distributed in that section. It is extended as far as it is required to secure the desired voltage regulation, and no further. This limitation of the 3-phase circuit, with resultant economy, is feasible because 3-phase

service is not offered to the individual consumer except for exceptionally large loads. In practice, the 3-phase circuit forms approximately one-third of the total length of circuit; located along the main highway it constitutes the backbone of the distribution system and from it, at each intersecting cross-road, are carried single-phase, 2,300-volt branch circuits, connected alternately to the three phases of the main circuit. One conductor of the single-phase circuit is grounded. Connections to the ground are made at the sub-station and at each service transformer; these being required on the average at about one-quarter of a mile apart.

The Rural Secondary or Service Circuit

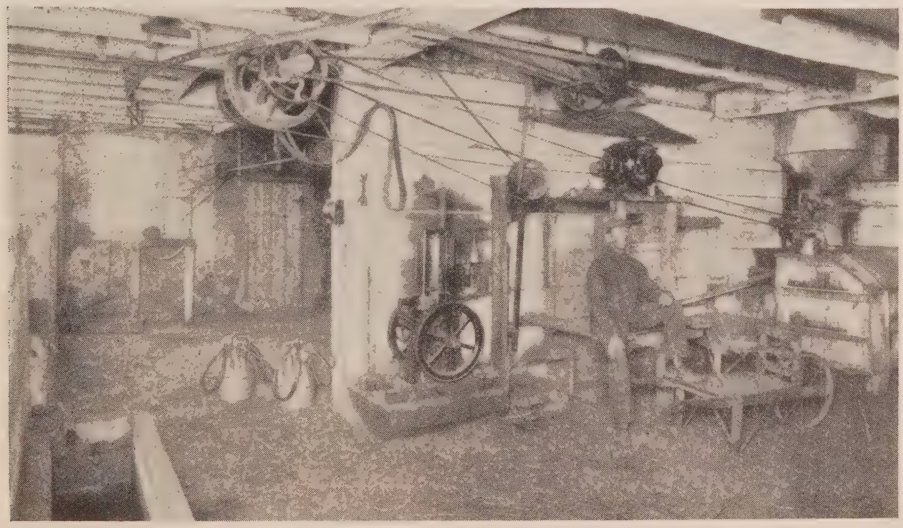
Adjacent to or on the property of the consumer, a transformer is installed in order to reduce the voltage from the 2,300-volts of the primary circuit to the 220 or 110 volts for the service circuit. For safety it is found desirable to avoid carrying the 2,300-volt circuit on to the property of the consumer and, therefore, this circuit is confined to the highway unless the consumer's buildings are located at an unusually great distance from the highway.

Single-phase, 110-volt service is supplied for the use of consumers having an average lighting load; 220/110-volt, 3-wire, single-phase service is supplied for consumers with electric cooking ranges or motors of 2, 3 or 5 horse power. Upon the average farm larger demands are uncommon, although occasionally it is found advisable to provide 3-phase, 220-volt service and in exceptional cases, 3-phase, 550-volt service.

Design of Overhead Distribution System

Low First Cost Essential

The distances between consumers along the highway in the country is, of course, much greater than in the



A Class 3 service in Woodstock Rural Power District. The gas engine has been superseeded by the 3h.p. motor and is now for sale.

TABLE NO. 1

SERVICE CHARGE

25 Cycle Service Based on 3 Farm Contracts per Mile.

Year	1-A	1-B	1-C	2-A	2-B	3	4	5	6-A	6-B	7-A	7-B	Remarks
1921	...	2.15	...	2.73	...	6.20	6.71	8.17	...	12.95	...	19.13	Without Subsidy.
	...	1.97	...	2.50	...	5.07	5.58	7.04	...	10.91	...	15.74	With Subsidy.
1922	1.47	1.71	3.04	2.50	3.95	5.07	5.58	7.04	...	10.91	...	15.74	
1923—Nov.	1.22	1.50	2.80	2.01	3.46	4.58	5.09	6.56	...	10.47	....	14.53	
1924—June	...	1.41	2.55	2.09	3.44	4.55	4.93	5.95	7.52	9.36	11.37	13.88	
1925—Jan. 12	...	1.62	2.97	2.03	3.11	4.10	4.28	5.18	6.53	7.47	9.81	11.88	
1926	...	1.62	2.97	2.03	3.11	4.10	4.28	5.18	6.53	7.47	9.81	11.88	

TABLE NO. 2

SUMMARY OF CONTRACTS APPROVED BY THE COMMISSION FOR CONSTRUCTION, TO THE END OF THE FISCAL YEAR 1925.

Rural Power District	Miles of Line	1-B	1-C	2-A	2-B	3	4	5	6	7	8	Total
Niagara System	1,079.03	7191	1233	697	870	1930	366	45	39	22	98	12,491
Georgian Bay System	60.74	392	51	15	4	84	12	14	5		3	580
Central Ontario System	59.21	301	39	22	30	60	1	12	10	5	4	484
Ottawa System	30.88	63	4	19	4	61	7		1	1	3	163
St. Lawrence System	37.02	115	5	5	4	44	1		4		3	181
Total	1,266.88	8062	1332	758	912	2179	387	71	59	28	111	13,899

TABLE No. 3

RURAL LINE CONSTRUCTION

Progress in Rural Power Districts.

Construction Approved by The Hydro-Electric Power Commission of Ontario									Municipalities Receiving Power.	
Year	No. of Consumers			Miles of Primary Line	Total Capital Invested					
	Hamlet	Farm	Total		Primary Lines	Secondary Lines and Equipment	Total		No. of Operating R.P.D.'s	Town-ships
1921...	587	666	1,253	211.29	$261,972.27	$ 181,904.36	$ 443,876.63		*1	*57
1922...	1,322	904	2,226	530.84	643,121.23	482,646.89	1,125,768.12		30	85
1923...	3,071	2,170	5,241	1,058.59	1,244,520.70	888,504.42	2,125,025.12		52	116
1924...	7,007	3,253	10,260	1,205.19	1,473,785.95	972,341.78	2,446,127.73		82	131
1925...	9,394	4,505	13,899	1,525.21	1,903,996.56	1,345,404.57	3,249,401.13		95	152

*A number of Township Municipalities received power from the H.E.P.C. through various sources previous to the year 1921. Since 1921, most of these Townships have been absorbed in the Rural Power Districts formed since 1921.

cities, and consequently the length and therefore the cost of line per consumer and also the cost of operation and maintenance is likewise greater.

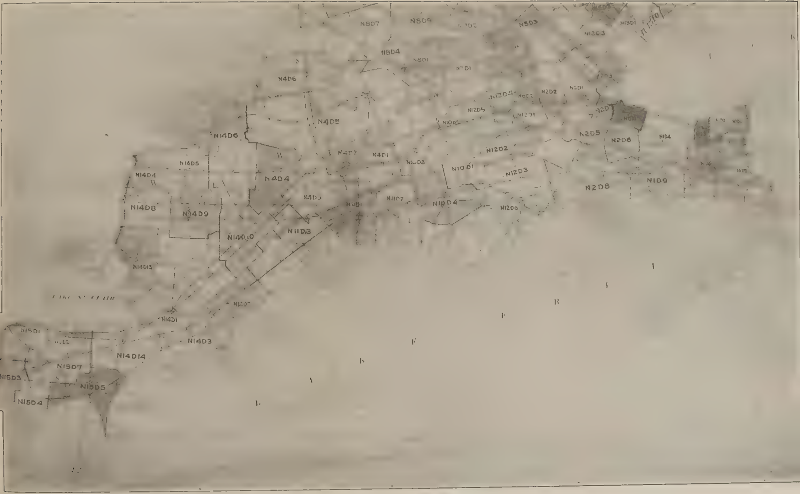
Being familiar with the town service rates, and not always appreciating the extent to which the above-named factors affect the cost of rural power, the rural consumer does not at first take kindly to the necessarily higher rates. It is, therefore, essential to install a type of construction having low capital cost in order to obtain such rates as will be attractive to the farmer. On the other hand, the construction must be mechanically strong for safety in order to avoid interruptions to service and to keep down maintenance costs. The electric characteristics of the conductors and equipment must be ample because the farmer will not be content with a quality of operating service inferior to that supplied in the towns. All such conditions have been given due consideration in the design and construction of the lines standardized by the Hydro-Electric Power Commission of Ontario. To a large extent, the commission's experienced construction force is supplemented by local labour, thus reducing the cost of transporting labourers from place to place and the cost of the lost time involved in so doing. The farmers themselves are willing to engage in the work, appreciating the fact that a reduction in the cost will be reflected in the rates, because the power is sold *at cost*. Competitive tenders also are received from contractors and much of the rural work is done on contract basis.

Lines are Built on the Highways

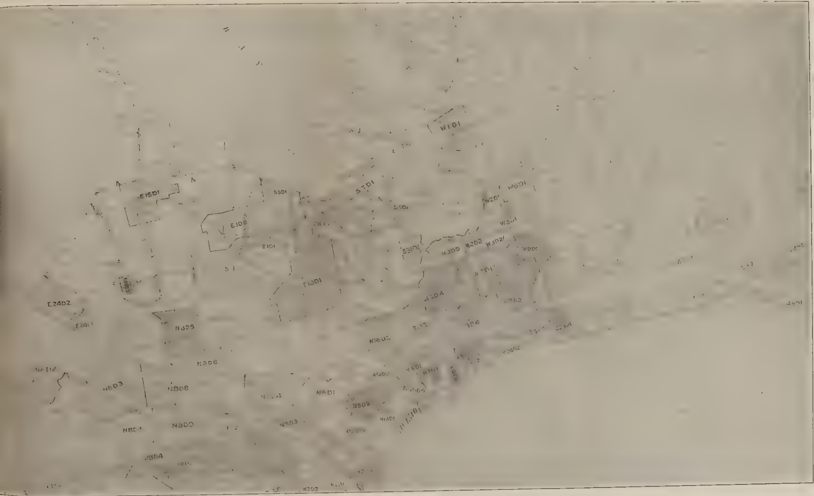
Farm dwellings and barns are usually located reasonably close to the highway and lines on the highway are therefore conveniently situated for the connections to the farm buildings. Trees form perhaps the greatest obstacle to these lines, although telegraph and telephone poles are commonly encountered. The use of the telephone is very general in rural districts in Ontario and telephone lines are frequently found on both sides of the highway. In a few cases arrangements have been made for the joint use of poles for telephone and power wires. Where the poles of a power transmission circuit of higher voltage have already been erected along the highway, such poles are used for the support of the conductors of the rural circuit, thereby avoiding duplication of poles.

Poles, Pole Spacing, Crossarms and Other Pole Fittings

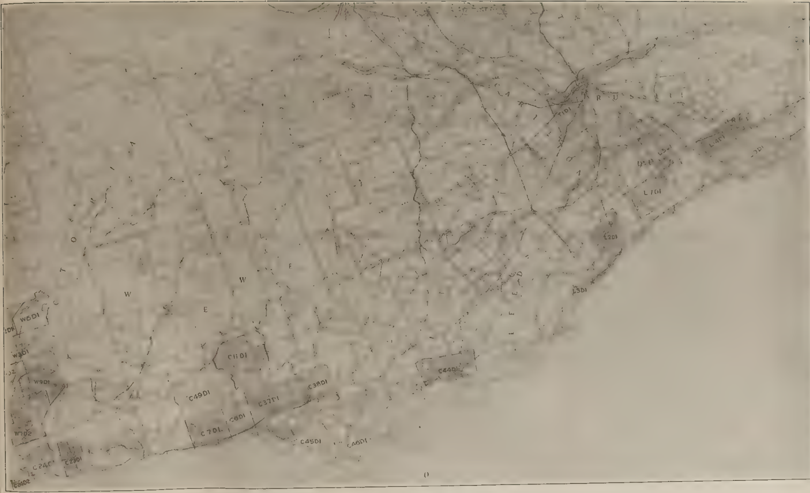
The standard pole used is of eastern Canada cedar and is 30 feet in length, with a diameter at the top of 6 inches. These poles are set 5 feet 6 inches in the ground on tangents and 6 inches deeper at curves, corners or terminals. Poles of greater height are occasionally required to provide clearance from trees and foreign pole lines. At railway crossings, the poles are required to be of 7-inch diameter at the top and of sufficient height to permit clearance of 30 feet between the rails and the power wires. The maximum spacing between poles is 160 feet, and this spacing is commonly obtained. It is, however, reduced at curves in the road and in spans



Rural Power Districts in South Western Ontario.



Rural Power Districts in South Central Ontario



Rural Power Districts in South Eastern Ontario.

adjacent to corners, as well as in terminal spans. At consumer's premises, also, poles must be located for convenient connection to the consumer's buildings. For these reasons the average span may be considerably less than 160 feet. Where necessary, guys of stranded galvanized steel are installed. Where the four wires of the 4,000/2,300-volt circuit are to be supported, crossarms are used, the dimensions of which are 3¾ inches by 4¾ inches by 6 feet 4 inches. The material is British Columbia fir. The spacing on the crossarm between the outer and the adjacent conductors is 18 inches with 30 inches between the two conductors adjacent to the pole. The crossarm is secured to the pole by a 5/8-inch machine bolt and by two flat steel braces 30 inches in length. Where only two conductors are required for the 2,300-volt, single-phase circuit, crossarms are not used. The ungrounded conductor is carried on a steel pin projecting above the top of the pole and the grounded conductor on a steel bracket on the side of the pole. Two feet vertical separation is maintained between the two conductors. All hardware used is galvanized. Porcelain insulators are used to insulate the ungrounded conductors and the grounded conductor is supported on glass insulators.

Conductors

For the primary circuit, hard-drawn copper is used, the cross section of which must not be less than No. 6 B. & S. gauge. This minimum is determined for reasons of mechanical strength and not on account of electrical conductivity. Joints in this conductor are made with copper sleeves, twisted.

To an increasing extent stranded aluminum conductor with steel core is being used for the primary circuit. This type of conductor permits the lengthening of the span between poles with a decided reduction in the cost of the line. The standard span for such construction is 250 feet. Where secondary circuit is required intermediate poles are located providing spans of 125 feet.

The use of steel wire for line conductors has been discontinued.

Bare wires are the rule for all primary circuits in rural districts.

In hamlets and occasionally even in the country itself two or more consumers may be found located favourably so that they may be served economically from one transformer. For such cases the 3-wire secondary circuit (200/110 volts) required along the highway is supported in a vertical arrangement on a steel bracket fastened to the side of the pole. The neutral conductor is placed above the others to provide greater safety in the event of a primary wire falling across the secondary circuit. The neutral wire is bare and the other two are provided with a double braid weatherproof covering. The wires of this circuit are, without exception, medium hard-drawn copper and all joints are soldered. No. 6 B. & S. gauge is the minimum size used. For connections from the pole on the highway to the consumer's premises, medium hard-drawn copper conductors are used, all conductors having a double braid weatherproof covering and being not less in cross section than

No. 8 B. & S. gauge. All conductors carried over railroads are required to have a strength not less than that of No. 4 B. & S. gauge copper, and to be stranded. This applies to the conductors in the crossing span and the adjacent span on either side of the crossing.

Transformers and Meters

Due to the fact that the average number of consumers per service transformer is small, little advantage is obtained in diversity of the load on the individual transformer. The transformer must be capable of carrying the maximum load which is usually of short duration. On the other hand the number of transformers connected to one feeder is large, due to the relatively small average transformer and also due to the fact that there is a high diversity in the transformer demands on the feeder. At the time of peak load on the rural feeder there is, therefore, a large number of transformers from which the consumers are drawing little or no current, and these lightly loaded transformers result in a low power factor for the load on the feeder, which is of course undesirable. To ameliorate this condition, particular care has been taken in specifying that transformers shall have low exciting current. In other respects, the transformers are similar to those used in urban systems. The rated voltage is 2,200/220-110. The minimum size used is of 2 kv-a. capacity and there is more demand for the 3 kv-a. than for any other size. Each service transformer on the overhead lines is protected by a lightning arrester and fuse cutout. Watthour meters are used for measuring the consumer's power consumption. These are placed inside the consumer's house or barn, or infrequently, in a wooden housing on a pole on the consumer's property. The ratings of the meters commonly required are 10-ampere, 2-wire, 110-volt and 15-ampere, 3-wire, 220/110 volts and for either 25 or 60 cycles.

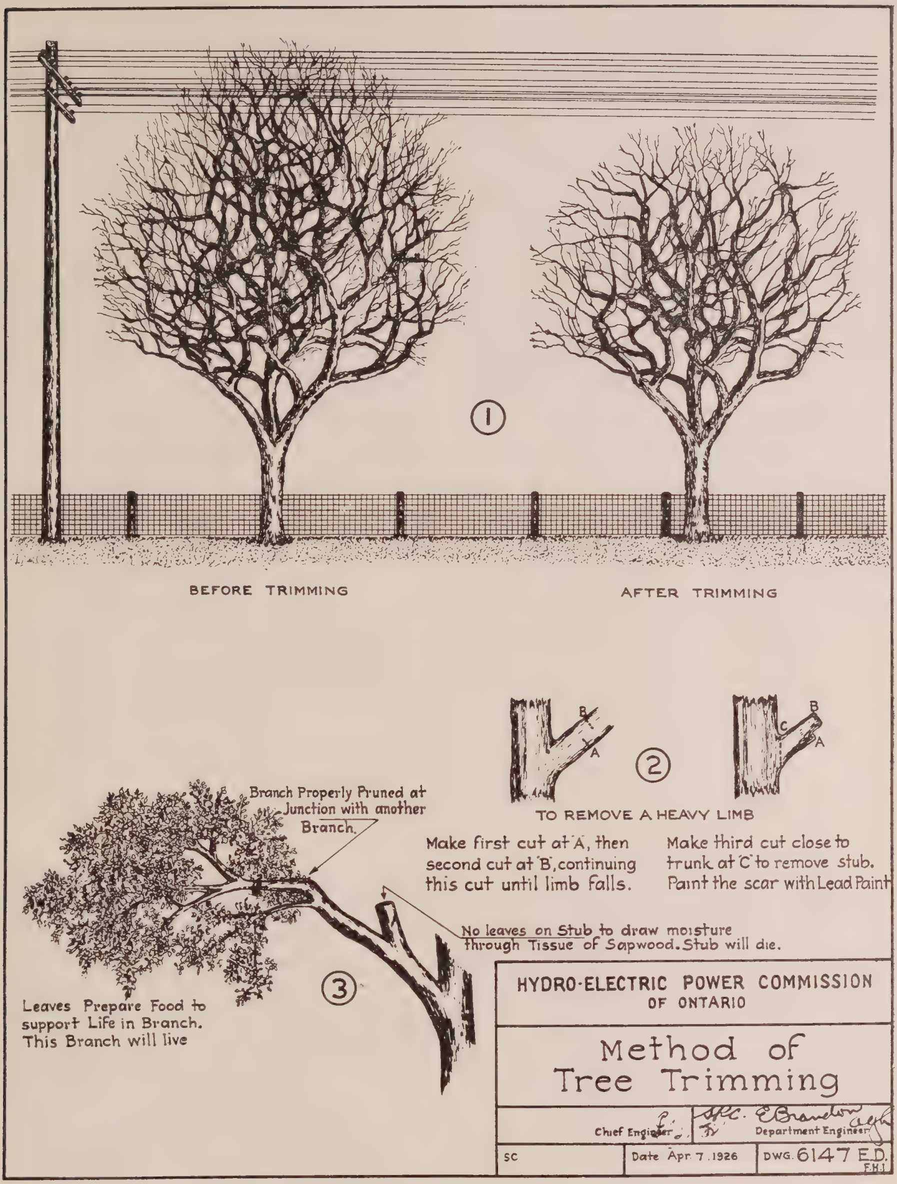
The Proper Trimming of Trees

PROPER tree-trimming is an art and like all other arts requires that thought and care be devoted to it.

Since the primary object of trimming a tree is to obviate cutting it down altogether the first consideration is the preservation of the tree and heavy pruning should be done at times when it is likely to cause the least injury.

The safe time to prune shade trees is during the dormant period, which, in Canada, is generally between November 1st and April 1st. The best time to prune trees is between February 1st and March 15th or April 1st., except in the case of maples, which bleed profusely. Hard or sugar maples, especially, should be pruned when the leaves are not functioning, preferably in late winter before the sap begins to rise.

The manner in which the pruning is carried out is also of importance. Branches should be removed at



their junction with the parent trunk or with other branches, and, in the case of the smaller branches and twigs, just above a bud from which a branch is likely to spring. If cuts are made any distance from other branches or from buds, stubs will be left which will certainly die back to the first living branch, and decay may continue downward into the branch or trunk.

The surfaces of the wounds should be weatherproofed by applying a good grade of lead paint of an in-

conspicuous colour over each.

The next consideration is to ensure as far as possible that the trimmed tree shall not be shorn of its beauty. Indiscriminate slashing off of branches without any regard being paid to appearance, may convert a lovely outline into a misshapen or jagged one.

The natural shape of any tree grown where it has a sufficiency of space, light and air, is usually of great beauty; moreover, different kinds of trees have their own distinctive shapes. Proper tree trimming will, as far as possible, preserve the natural shape of the tree, but if this cannot be done, an attempt will at least be made to obtain symmetry of outline.

Fortunately, most people are lovers of trees and this very fact prevents merely utilitarian ideas from prevailing altogether, though it must be admitted that, in the past, those responsible for carrying out the work of tree trimming have but too often neglected the aesthetic side of their work.

It has come to be recognised too, that to trim trees in a slovenly manner is not only damaging to the appearance of the tree but seriously injures the relations between the public and those responsible for such vandalism.

Figures 1, 2 and 3, accompanying this brief article illustrate some of the features of tree trimming to which reference has been made.

My Cheapest Bill

There is no dollar I expend
That brings back more to me,
Than does the dollar that I spend
For Electricity!
I never think my bills are high,
(Tho' some may think they're steep)
There's not a thing that I can buy,
That comes to me as cheap.

There is no service on the earth
From food, to coal, or ice,
That gives me greater money's worth,
However low its price.
And there's no service, barring none,
That mankind can procure,
To work for us from sun to sun,
Of which we are as sure.

When I go home at eventide,
A magic wand I wave,
And I am served on every side
By this unfailing slave.
There is no genii of my dreams,
That better heeds my wand,
It never fails (or so it seems)
At all times to respond.

And so I say I'm glad to pay
My light bills all the while;
They pay for that which night and day,
Contributes to my smile.
Some bills are like a bitter pill,
My bank account they wreck,
But when I pay my power bill,
I, gladly sign the check.

—C. S. Kinnison.

The Detroit Edison Synchroscope

A Metallurgical Microscope

THE laboratory of the Commission has recently installed a modern metallurgical microscope. Such an instrument is now considered a necessity in any laboratory which has to deal with metallurgical matters. The heavy shafts and castings now being used in the large units present many difficulties not usually found in materials for ordinary purposes. Representative samples from these shafts and castings are examined microscopically to determine the condition of the metal. But apart from this important service, the microscope is in almost daily use in the study and investigation of other problems connected with the more common materials.

Fig. I is a photograph of the instrument. The microscope is shown in the centre. At the right is the lamp with a condensing lens, and the camera is on the left. These are all mounted on a rigid cast iron base, which in turn is supported on coiled springs known as shock absorbers. The shock absorbers serve to reduce vibrations due to outside conditions, such as a passing train, as vibrations always cause considerable trouble in photographing, especially at the higher magnifications. The parts shown on the table in front replace the regular microscope when low power work is desired.

The microscope is of the inverted type, that is, the specimen to be examined is placed on top instead of below the lens as in the ordinary type. The focus is altered by moving the specimen instead of the lens. Magnification is obtained by means of a combination of an objective and an eyepiece. The objective is shown immediately under

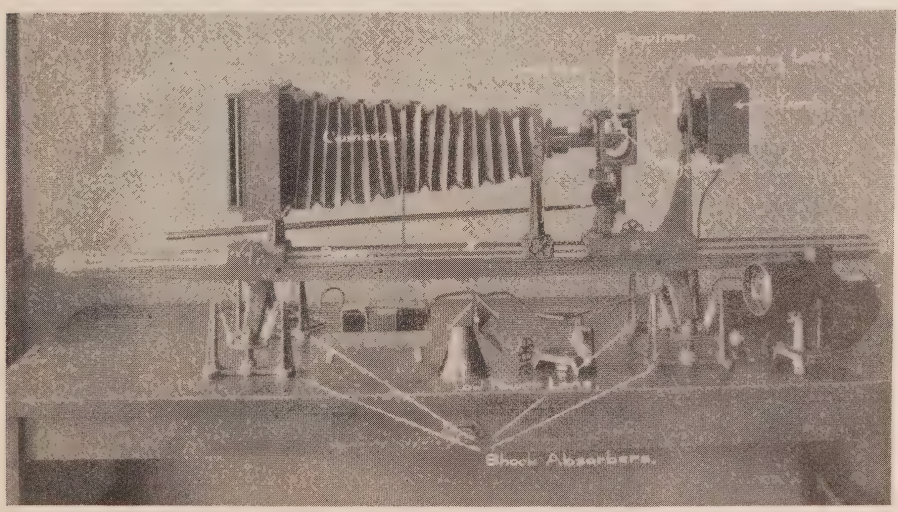


Fig. 1. Metallurgical Microscope.

the specimen and the eyepiece is shown at the left of the frame. Both of these are supplied in different powers and magnifications are changed by using different combinations. With the equipment as illustrated, it is possible to make photographs varying from 50 to 6,000 diameters, while with the low power attachments magnifications from 7 to 22 diameters are possible.

There are one or two special features in connection with this instrument that are worthy of notice. The lamp and the microscope are both rigidly fixed to the same base. Alterations in both the focus and the magnification can be made without readjustment of the light. This was a necessary and troublesome operation with the older types. A second very important feature is the convenience in changing from visual examination to the use of the camera. This can be accomplished in a second without disturbance to any of the adjustments by pulling out the eye piece a short distance. This removes a reflector and allows the image to pass through the horizontal tube to the camera. The photograph is taken as with an ordinary camera.

Before the crystal structure of metal can be examined in a microscope, it is necessary to give the specimen a special preparation. This consists in first obtaining a very smooth and highly polished surface. The polished surface is then etched with a suitable reagent to show the crystal structure. The etching soution acts more readily on some crystals than on others, and if the action is stopped at the proper time, the crystal formation can readily be seen. The selection of the reagent to be used will depend upon the metal to be examined and the characteristics to be observed.

One or two photomicrographs will illustrate the appearance of metal under the microscope. Fig. 2 shows ordinary steel in its cast condition. The white portions are the ferrite and the black portions represent pearlite which is a combination of iron and carbon. Note the triangular formation and the large size of the crystals, both of which are characteristic of steel in its cast condition. Proper heat treatment or annealing would break up this formation and diffuse the pearlite and ferrite in small particles throughout the mass. Such a condition is shown in Fig. 3 which is a steel which has been annealed. Fig. 4 shows steel which has been cold worked, and the deformation of the crystals due to this work can be seen readily.

Fig. 2. Steel in its cast condition. Magnification 100 times.

Fig. 3. Same steel as shown in Fig 2. after being annealed. Magnification 100 times.

These illustrations show clearly the wide variations in the internal structure of a metal. Investigations have shown that the physical properties of a metal are closely related to the size and shape of the crystals. Thus the information to be obtained from the study of the crystal structure is a very valuable supplement to the physical test and the chemical analysis. The later gives the potential properties of a metal, the physical test gives its present properties, but neither of these may indicate the treatment it has received.

As already mentioned, the microscope is used to examine the metal in all the large shafts and castings used in the large units. This is made a part of the regular inspection for such parts in addition to the regular physical tests and chemical analysis. Specimens are taken out of the part by means of a hollow drill at such locations as will not interfere with the service of the shaft or casting. These specimens are tested for physical properties and a portion is examined under the microscope. This examination will give additional information. If this is not satisfactory it may indicate that a different heat treatment will be beneficial or it may show that the metal is inherently defective. In case of the large rotor spiders weighing 30 tons or more, four such hollow drill specimens are taken from each casting. These are taken 90 degrees apart and extend to approximately the centre of the casting. This method gives reasonable assurance of the uniformity of the metal and the heat treatment. Large forgings are handled in the same manner but in this case it is only possible to take hollow drill specimens from the ends. It is generally possible, however, to take small specimens for microscopic examination from the rough forging wherever desired if the hollow drill tests are not considered sufficient.

The microscope is not used in the inspection of materials of lesser

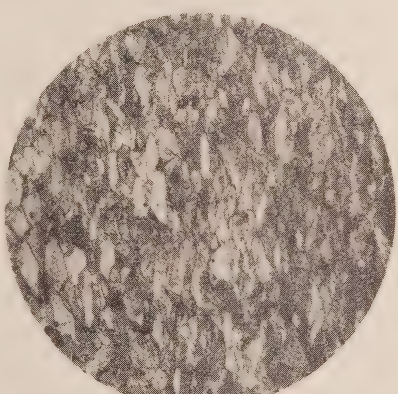


Fig. 4. Steel that has been cold worked. Magnification 100 times.

importance unless the physical tests indicate material of questionable quality. It is most useful, however, in investigating metals which are not giving the service required. This service can very often be improved by altering some details, as revealed by the crystal structure, such as the grade of material, its heat treatment, or its manufacture. A few examples such as brasses, bolts, pipe, galvanized coatings, wire and case hardening will serve to show the wide range of usefulness of the instrument in this respect.

Everyone is familiar with the great development in the metallurgical science during the past few years and the microscope has been most helpful in this great advance. Its service is now being extended to other commercial materials and it will no doubt prove of great help in these other lines. While the Commission has so far used the microscope in the examination of metals only, it is expected that it will be just as useful for such other materials as paints, rubber, and concrete, as soon as it can be adapted to them.

Power Output in 1925

THE report covering the annual survey of the central station industry in the United States and Canada by the Electrical World is shown in the April 24, 1926 issue of that publication. It is headed "Hundred-Million-Kilowatt-Hour Utilities" and contains much information of interest. It shows 7 systems in Canada to have had an output in excess of this amount and 110 in the United States.

The Niagara Falls Power Company is shown as having reported the largest output in the United States with 3,161,130,010 kw.-hr. The Hydro-Electric Power Commission of Ontario is shown to have reported the largest output of all the systems in the world, with 3,298,347,874 kw.-hr. The highest peak-load was reported by the Commonwealth Edison Company, being 809,000 kw. The Edison-United Companies, New York, was second with 656,312 kw. The Hydro-Electric Power Commission is third with 635,485 kw. instantaneous demand.

The following tabulation shows the details reported by the seven Canadian systems included in the report and also by the first seven of the United States.

CANADA.

System	Peak Load kw.(Instantanious)	Peak Load (Est. Over 30 Min. Period kw.)	Output for year kw-hr.	Average L'd in 1925, kw.
Hydro-Electric Power Commission of Ontario........	635,485	628,985	3,298,347,874	376,409
Shawinigan Water and Power Company................	371,002	371,002	2,421,046,311	376,000
Montreal Light, Heat and Power Company..........	233,230	233,230	1,175,430,654	134,182
British Columbia Electric Railway Co. Ltd..............	83,100	78,400	336,907,650	38,460
City of Winnipeg Hydro Electric Systems..............	60,321	59,480	261,996,380	29,270
Winnipeg Electric Company..	61,100	56,100	252,891,600	28,850
Kaministiqua Power Company.	28,000	25,300	107,576,036	12,290

UNITED STATES.

System	Peak Load kw.(Instantanious)	Peak Load (Est. Over 30 Min. Period kw.)	Output for year kw-hr.	Average L'd in 1925, kw.
Niagara Falls Power Company.	......	437,016	3,161,130,010	360,860
Commonwealth Edison Company....................	809,000	792,000	3,091,424,000	353,000
Edison United Companies, New York....................	656,312	642,907	2,262,620,409	258,290
Pacific Gas and Electric Company....................	380,084	......	2,001,474,640	228,479
Southern California Edison Company................	395,900	......	1,987,661,654	226,902
Detroit Edison Company.....	390,100	389,100	1,732,420,700	197,800
Philadelphia Electric Company System.............	387,200	361,600	1,521,639,979	173,815

The Electrical Iron Fire Hazard

(From pamphlet by National Fire Protection Association, Boston, Mass.)

A TRUE STORY

About a Four Million Dollar Fire

Once upon a time a lady ran a small department store. Late one afternoon she was using an electric iron. When she finished ironing, she put the iron aside. She locked up the store and went home. She thought she had turned the iron off.

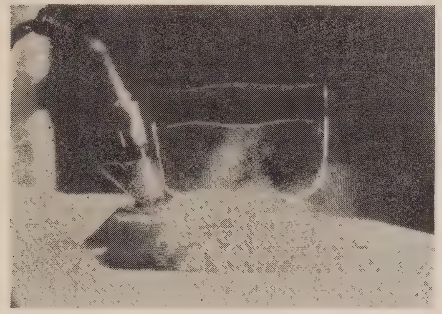
The next morning the best part of the city was in ruins, three thousand persons had no homes, a thousand more were out of work. The iron had set fire to the building and the building set fire to the city. (Both the building and the city had been built to burn; most American cities are built that way—but that is another story.)

This is a true story. It happened in Augusta, Georgia. It cost United States over four million dollars to rebuild that city.

ELECTRICITY is one of the major causes of fire, but misuse of the electric pressing iron is responsible for nearly half of all the fires assigned to that cause. In a typical week 540 electrical fires were reported from all over the country. Two hundred and fifty-two, or 47%, were caused by electric irons left in circuit. Flexible cords (many of them used with irons) were responsible for 83 fires, or 15%, while the remaining 206 fires, 38%, were assignable to numerous causes of lesser importance. In a single year electric irons add $10,000,000 to the already staggering national fire loss!

Fires are always fraught with danger to human life; electric iron fires particularly so. Not infrequently an iron is used in the evening and left carelessly in circuit. Fire breaks out later, after the family has retired, and they wake up to find themselves surrounded by smoke and flames, with little chance to escape. Such loss of life occurs for the most part among women and children. It is obvious that the utmost care must be observed with the electric iron and that it should be surrounded with every safeguard.

The appeal of the electric iron is its convenience; it can be attached to any lamp socket in any part of the house or shop; but in this fact lies a large element of its hazard. Irons are found not only in the home, but in many manufacturing and mercantile establishments. The fires usually start from irons that have been carelessly left with the current on. Sometimes, where cords are left attached, the current is unknowingly turned on later by some person. Any combustible material in contact with the iron will ignite sooner or later.

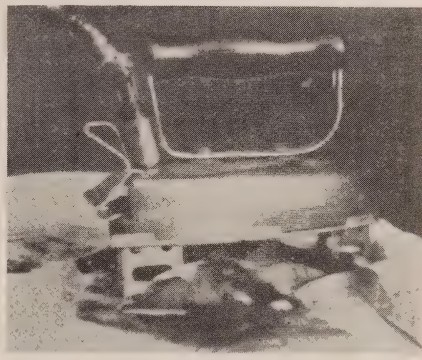


Many means have been suggested to lessen this hazard of the electric iron. The most successful device, however, is the iron controlled by an automatic temperature control switch, which prevents the iron from attaining dangerous temperatures. This type materially lessens the hazard and will do much to prevent fires.

But few irons are made with this thermostatic regulator, and the ordiary iron cannot be safeguarded to prevent fires if the current is left on. Using good stands and thermostatically controlled irons will help, but the hazard can only be eliminated by keeping the iron shut off!

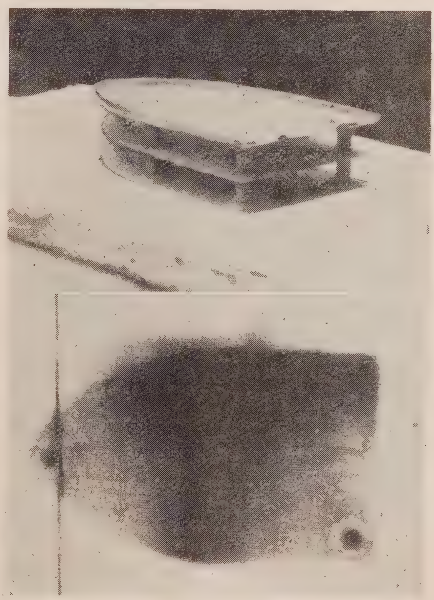
STANDS.

The purpose of a pressing iron stand is to keep the iron away from the combustible ironing board during the brief periods when the ironer stops to rest or adjust the work. An iron left with the current turned on can start a fire even it it is on a stand like some of those furnished, as the picture below shows.

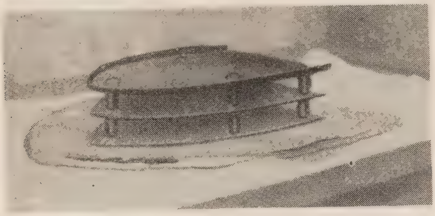


Most electric irons can get as hot as 1800° F., nearly a red heat, and will readily ignite any adjacent combustible material. Not many ordinary stands will hold the iron safely except for short periods.

Some stands are better heat insulators than others. The one illustrated above has better insulating qualities than most stands. Its parallel plates and double air space do much to retard the flow of heat.



Yet an iron on this stand was able in a few hours to char the cloth covering of the ironing board to the ignition point, as the picture below it shows.



The safety of any stand can be much improved by using a sheet of asbestos millboard at least ¼ inch thick under it. It should preferably be fastened on to prevent the use of the stand without the board. A good stand does much to reduce the hazard.

Local Switch.

A switch at the iron itself helps to make it easy to turn off the current.

Warning Devices.

Pilot lights,are often used to give warning that the current is on the iron. The pushbutton switch is at the left, there is a plug receptacle for the cord at the right, and a red lamp in the centre which glows when the current is on.

But since a pilot light fixture confines the user of the iron to one particular location, it may not appeal to the housewife whose inclination is to plug the iron into any lamp socket in kitchen, nursery or summer piazza. In mercantile establishments, however, the arrangement is more practicable, and it has undoubtedly prevented many fires by offering a reminder, to those who are not indifferent to the hazard, that the current is on the iron.

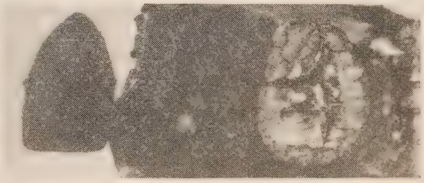
Cords.

The hazard of cords is common to all portable electric appliances. An electric iron's cord may be injured, due to the repeated insertion and removal of the plug and due to contacts with the hot iron. Cords should be replaced whenever breaks appear in their insulation.

Thermostatic Control.

It has been known for a long time that it is perfectly possible to safeguard from excessively high temperatures the electric iron within itself. Irons embodying devices to do this have been for the most part driven off the market, however, by cheaper irons, which are causing daily fires.

Irons, however, are being sold which contain a thermostat which cuts off the current when the iron gets too hot and turns it on again when the iron becomes too cool for ironing. A thermostatic switch is used to maintain temperatures between 400° F. and 600° F., the best ironing temperature range.



This control provides a large degree of safety over the ordinary unguarded iron. A comparative test of the two types on a white pine board with a cotton pad and muslin cover is shown in the above picture. The uncontrolled iron set fire to the board and cover, while the ther-

mostatically controlled iron gave the covering only a bad scorching.

Safety for the electric iron must be found in general, not in some mechanical "safety" device, but in the vigilance of the user. To make an electric iron safe, it must be shut off at all times when not actually in ironing use.

The only sure way to prevent fires from electric irons is to keep the current shut off, except while the irons are actually in use.

SAFETY RULES

For The Electric Iron

1. Use an effective stand.
2. Keep the iron away from combustible material.
3. Use, where possible, a pilot light or other warning signal.
4. Use an iron that controls its own temperature.
5. *Keep the current shut off, except when actually in use.*

Resuscitation From Electrical Shock

ON August 17th, 1925, William Koehler, an employee of the Kuntz Brewry Company, was on top of a refrigerator car filling it with ice. He raised himself up and came in contact with a 1,500 volt trolley wire above, receiving a severe electrical shock and stopped breathing. Word was immediately sent to the Utility office and Mr. George Grosz, the Manager, was asked to bring a pulmotor to assist the man. Mr. Grosz asked what they wished the pulmotor for and when he learned of the condition, he told them they did not need a pulmotor but that he would be right over. As soon as he arrived he started the Prone Pressure Resuscitation and continued it for about twenty minutes when the man started to breathe. The man was then taken off the top of the car, placed in an ambulance and taken to the hospital. When he was in the hospital, he became very violent and he required the services of three attendants to restrain him and finally about five hours later he became conscious and rational. After a time in the hospital, he was able

George Grosz, Supt. Water and Light Commission, Waterloo.

to leave and carry on his work as before.

By Mr. Grosz' knowledge and ability to perform resuscitation and his clear-headed action, a life was saved. On Tuesday, May 11th, 1926, he was presented with the Canadian Electrical Association Resuscitation Medal in the City Hall at Kitchener, at an Accident Prevention Meeting which was held at that time. Mr. Wills Maclachlan, acting for the President of the Canadian Electrical Association made the presentation.

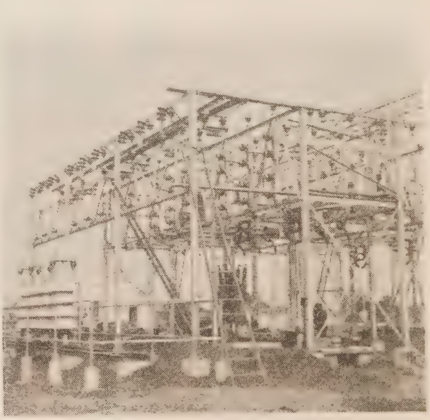
Dr. W. E Story, Kemptville

The sudden death of Dr. W. E. Storey on Wednesday, April 14th., removed one who had taken a keen interest in Hydro in Kemptville and had done much towards the establishing of the Kemptville Hydro System and the bringing to its present successful operation the Hydro System in that town. Dr. Storey had been a member of the Local Hydro Commission from the time Hydro service was first installed, up to the time of his death and had acted as chairman, and also as reeve of the village. His sound judgment and readiness to serve, will be much missed.

Saving the Pennies

Well managed corporations, no matter how large or wealthy, watch their slightest expenditures keenly to save every cent possible. An example of taking care of the pennies is found in the annual reports of the United States Steel Corp. For years the corporation has been gradually reducing the weight of its voluminous reports, thus saving a small amount in postage on each pamphlet, but quite a large amount when it is considered that probably close to 200,000 reports are sent out each year.

This year the big company has taken another decided step toward economy. Only a limited number of complete reports of 46 pages, bound as usual in heavy grey paper, were printed. To the 150,000 or more stockholders have been sent condensed reports of 21 pages, containing only the most essential features of the statement, and unbound. This undoubtedly saves several cents a copy in paper, printing and postage.—*The Wall Street Journal.*



Hydro News Items

Central Ontario System

Arrangements are being made by the Commission with the Canadian National Railways for rental of telephone communication between Toronto and Oshawa. This will greatly faciliate the service between the various offices of the Hydro in the vicinity of Oshawa and the Head Office at Toronto. It is expected that connections will be made in the course of the next month.

* * * *

Niagara System

A third transformer bank consisting of 3-5000 kv-a single phase transformers of outdoor type is being installed at Essex H. T. Station. Two new 26,000 volt feeders are also being added to this Station.

* * * *

Plans are well under way in connection with an additional substation in Windsor—3-3000 kv-a three-phase transformers are being purchased for this Station.

* * * *

A new outdoor Station is being constructed at Islington to take care of the load in the northern part of Etobicoke Township.

A new outdoor Station consisting of 1-300 kv-a three-phase transformer is being erected at Jordan Station to take care of the rural district load in that area.

* * * *

A new outdoor Station is being erected at Dashwood to take care of the load at Zurich and Dashwood and the Rural District as far as the eastern shore of Lake Huron.

* * * *

Additional transformer capacity is being installed in the Commission's Stations at Tavistock, Leamington and Harrow, and a new Station is being arranged for at Riverside, consisting of 1-1500 kv-a outdoor type transformer with provision for additional similar units.

* * * *

Rideau System

The Grenville Crushed Rock Company will again be operating during the summer of 1926, with a load similar to their demand in previous years.

* * * *

St. Lawrence System

Residents of the Police Village of Vars, Cumberland Township, are negotiating for rural service.

* * * *

The Trustees of the Police Village of Embrun have decided to receive

service in conjunction with rural residents in the Chesterville Rural Power District.

* * * *

Revised estimates on cost of power have been submitted to the Council of the Village of Finch.

* * * *

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in April, 1926.

Appliances

Belleville Electric & Stampings, Limited (Mfr.), 100 Church St., Belleville, Ont.

General Mercantile Sales, Ltd. (Submittor), 2480 Dundas St., West, Toronto, Ont.

Portable Pressing Irons, "G.M.S."

* * * *

Durable Electric Appliance Co. Limited, 81 Jarvis St., Toronto, Ont.

Electric Mantel Grate, Cat. No. C. 103.

Rectifier, Hot Cathode, Argon Gas-filled.

Marking: Nameplate with rating.

* * * *

D. Gestetner (Canada) Limited, (Submittor), 117A King St., West. Toronto 2, Ont.

Electric Rotary Cyclostyle Duplicators.

* * * *

Heat and Humidity Limited, 245 Confederation Life Bldg., Toronto 2, Ont.

Humidifier.

* * * *

The Preston Woodworking Machinery Co. Limited, (Submittor, Preston, Ont.

Stockbridge Machine Company (Mfr.), Worcester, Mass.

Portable Electric Knife Grinder and Jointer.

Marking: Manufacturer's name and motor rating.

* * * *

The Preston Woodworking Machinery Company, Limited, Preston, Ont.

Portable, Motor-driven Circular Saw. "Preston Woodworking Machinery Co. Ltd".

* * * *

Superior Electrics Limited, Pembroke, Ont.

"Superior" Portable Electric Curling Iron Heaters, Cat. No. 29.

Electric Air Heaters, Reflector Type, Cat. Nos. 75, 76 and 77.

* * * *

*Burdick Cabinet Co., Milton, Wis.

Portable Therapeutic Equipment, furnished in air-cooled and water-cooled types and combinations thereof. Cat. Nos. LA100, LA101, LA103, LA104, LA400, LA401, LA403, LA-404, LW200, LW204, LW205, LW210 LW500, LW504, LW505, LW510, LAW300, LAW306, LAW307, LAW-312, LAW340, LAW600, LAW607, LAW612, LAW616, LAW640.

Marking: Nameplate with manufacturer's name and address, catalogue number and rating.

* * * *

*Edwards & Co., Inc., 140th and Exterior Sts., New York, N.Y.

Transformers, Air-cooled. Cat. Nos. 86, 86-40, 86-25.

Marking: "Edwards".

* * * *

*Federal Electric Co., 8700 S. State St., Chicago, Ill.

Electrically illuminated display signs.

* * * *

*Keen Waving Co., Inc., 465 Greenwich St., New York, N.Y.

Permanent Hair Waving Machine, Types A. B. C. D.

Hair Dryer.

Portable Curling Iron Heaters.

Marking: "Keen".

* * * *

*Muter Co., Leslie F., 76th St., and Greenwood Ave, Chicago, Ill.

"Muter", "Guardian", "Protector" and "Security", Lightning Arrester, Air Gap Type.

Marking: Trade name molded in porcelain.

* * * *

*Pelton & Crane Co., The, 632-42 Harper Ave., Detroit, Mich.

Water Heating Instrument Sterilizer, Type No. 211.

Marking: Manufacturer's name, address, type number, and rating on rear wall of casing.

* * * *

*Wilson Welder & Metals Co., Inc., Wilson Blgd., Hoboken, N.J.

Electric Arc-Welding Machines, - Type.S

Marking: Nameplate.

* * * *

Fittings

*Magnus Electric & Radio Mfg. Corp., 787-95 East 138th St., New York, N.Y.

Attachment Plugs, separable and non-separable, Cat. Nos. 1, 22, 32.

Cord Connector, Cat. No. 48.

"Magnus Plugall" Attachment Plug, Cat. Nos. 9 and 95.

Marking: "Magnus" and catalogue number moulded in body.

Weatherproof composition sockets, Cat. No. 54.

Marking: "Magnus".

* * * *

*Wood Electric Co., C.D. Inc., 565 Broadway, New York, N.Y.

Medium Base Receptacles, Porcelain Shell, Keyless, Cat. Nos. 420-24 incl.

Composition, flush, single and duplex outlet Receptacles for Attach-

ment Plugs and Plugs, Cat. Nos. 411-12.

Marking: "Woodwin".

* * * *

*WOODHEAD CO., DANIEL, 15 N. Jefferson St., Chicago, Ill.

Socket Guard.

Marking: "Protex" and manufacturer's name moulded in the rubber.

* * * *

*YOST ELECTRIC MFG. CO., THE, Toledo, Ohio.

"Yost" Medium Base Sockets, metal shell, keyless, Cat. Nos. Y-300, Y-305, Y-310, Y-315, 1719.

Marking: "Yost" and rating on device.

* * * *

Switches

ACTON TOOL AND STAMPING CO., LIMITED, 20 Hayter St., Toronto, Ont.

Cutout Boxes, sheet metal, Type "E".

Marking: A.T.S.Co. in a diamond.

* * * *

*CONDIT ELECTRICAL MFG. CORP. South Boston, Mass.

Switches, Oil-break (As listed on Underwriters' Laboratories card dated February 12, 1926).

Marking: "Condit".

* * * *

Portable Lighting Devices

ART-CRAFT PRODUCTS CO., Sycamore, Ill.

Portable Electric Lamps.

Trade Mark: "A hammer C".

* * * *

ART LAMP MANUFACTURING CO., 1433-37 South Wabash Ave., Chicago, Ill.

Portable Electric Lamps, "Almco".

* * * *

ART NOVELTY STUDIOS, 227 Victoria St., Toronto, Ont.

Portable Electric Lamps, "A.N.S."

"Radio-Lite" Combination Portable Electric Lamp and Radio Loud Speaker.

* * * *

L. D. BLOCH & CO., 37-41 East 18th St., New York, N.Y.

Portable Electric Lamps "Bloch".

* * * *

THE BRADLEY & HUBBARD MFG. CO., Meriden, Conn.

Portable Electric Lamps "Bradley & Hubbard Mfg. Co."

* * * *

CANADIAN FLOOD LIGHTING COMPANY, LIMITED, 124 Adelaide St. W., Toronto, Ont.

Portable Electric Fixtures "Canadian FL Reflector".

* * * *

THE ROBERT MITCHELL CO., LIMITED, 64 Belair Ave., Montreal, Que.

Portable Electric Lamps "Mitchell Montreal".

* * * *

Miscellaneous

*Buffalo Fuse Corporation, (Mfr), 752 Main St., Buffalo, N.Y.

Pierce Fuse Corporation of Canada Ltd., (Submittor), Bridgeburg, Ont.

Cartridge Enclosed Fuses, Renewable, "Pierce".

* * * *

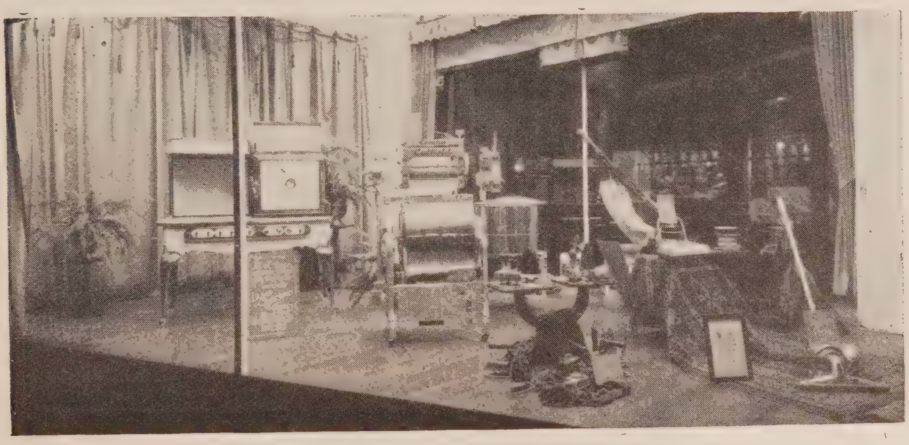
*These devices are under the Underwriters' Laboratories re-examination or Label Service.

Hydro Needed Here

Ontario housewives may well drop a tear for their less fortunate sisters of Wales, N.D. According to "Engineering World", the following letter was recently addressed to patrons of the Electric Light Association at Wales:—

"Regarding electric power on Tuesdays—the plant will put out only 20 amperes. An iron pulls about five amperes and a motor for washing about two amperes. The plant will thus handle only four irons at one time. There are eight who have them and the four to use it in the morning are: Mrs. Geo. H. Johnson, Mrs. Geo. Lachner, Mrs. J. Levin and Mrs. Platz. The four in the afternoon are: Mrs. Fischer, Mrs. Fraser, Mrs. Nelson and Mrs. Wareburg. If any others want to use power at this time they will have to see the engineer.

"It is for your own good to observe these rules. If more go on than the plant will handle you will not get the power you want, and besides, you might hurt the engine by overloading."—*The Canadian Engineer.*



Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
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Per Year

Galt Memorial Tablet to Sir Adam Beck

1858 - 1925

"In grateful and affectionate remembrance of Sir Adam Beck, without whose knightly courage and inspiring zeal this building and all for which it stands would not have been, and whose enduring monument is to be found in the thousands of grateful hearts and busier hands and happier homes all over this broad province, whose individual and civic life has been helped and quickened by his hopeful vision, his untiring energy and his unselfish toil."

"Great was the glory, for the strife was hard."

SUCH is the inscription on the tablet erected on the building of the Public Utilities Commission of Galt, and unveiled on Friday, June 4th. In the absence of Chairman C. A. Magrath of the Hydro-Electric Power Commission of Ontario, on account of the serious illness of Mrs. Magrath, the tablet was unveiled by Commissioner C. A. Maguire, who was one of the staunchest supporters of the late Sir Adam Beck, and one who had stood by him in many a hard fought battle.

After a dedicatory prayer by Rev. J. J. Macdonald, Mr. Maguire unveiled the tablet, saying, "In unveiling this tablet to the memory of Sir Adam Beck, a great Canadian with a splendid vision and fine courage, who devoted his whole energies with a single eye to the good of this province, let this tablet always be an inspiration to those engaged in the work of the Hydro-Electric Power Commission of Ontario, to loyally carry on in the best interests of the municipalities this great public ownership project to which Sir Adam unselfishly devoted his life."

The unveiling ceremony over, the participants went to the City Club where a dinner was served under the presidency of S. J. Webster, Chairman, Galt Public Utilities Commission. At this dinner, Mr. Maguire

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outlined the progress of the Galt Utilities in the distribution of Hydro power, and eulogizing Sir Adam Beck for the stand he had taken regarding questions affecting the whole Hydro scheme.

Following Mr. Maguire, Mr. F. A. Gaby, Chief Engineer, Hydro-Electric Power Commission of Ontario, spoke of his personal contact with Sir Adam Beck and of the necessity of being prepared to meet a power shortage in the near future, outlining steps that had been taken in that direction. Other speakers were, Rev. R. E. Knowles, who drafted the inscription on the tablet, Mayor Gardner, A. E. Buchanan and Rev. Father Doyle.

Galt Public Utilities Commission Building.

Electrical Hazards and the Safe Use of Electrical Apparatus

By F. A. Gaby, Chief Engineer, H.E.P.C. of Ontario

(Presented at the Convention of the Industrial Accident Prevention Association, Toronto, May 12, 1926)

I THANK you very much for the honour you have conferred upon me in inviting me to attend your Conference and present a paper on "Electrical Hazards".

The Hydro-Electric Power Commission has a very real interest in the work of your various Associations. By statute, the Commission is empowered to prepare and to enforce regulations for the installation of safe electrical wiring and appliances in the residences, stores and factories of the Province; and furthermore, in the operation of the great electrical utility properties entrusted to the Commission, it is in the general interest that the service be rendered in a safe manner, both with regard to the Public and to the Commission's own employees, and I welcome, therefore, the opportunity to present information regarding the safe use of electrical apparatus and accident prevention as stipulated by the Commission's regulations.

The very extensive use of electrical equipment and appliances in Ontario has made it necessary to impose rules and regulations for their installation and operation, in order to avoid the danger of electrical shock and fires. The necessary precautions are relatively simple, provided that fundamental principles are understood and practised. Because electrical shock may prove fatal even with potentials as low as 110 volts when conditions of contact and "ground" are favourable, it is essential to exercise care in the design and installation of equipment and appliances in order to prevent persons using them from coming into actual contact with conductors carrying electrical currents.

Character of Electrical Hazards:

Bodily injury from electrical sources may be occasioned in two ways—

First, if a contact be made between two electrically charged or live conductors or between one conductor and ground or plumbing, an electrical shock will ensue.

Second, if during the contact an electrical arc is generated, destruction of tissue will occur; also, if the body is close to an electrical arc or flash, severe burns and possibly flashed eyes will be the result. If the arc or flash is of a minor character, the results may not be severe but with the large amounts of power generated and used on some systems the resultant arc may be disastrous.

With high-pressure industrialism, and the tendency to higher efficiency with greater output and intensity of

effort, human life is in ever increasing danger and no system of compensation can fully repay society for life forfeited or repair the loss suffered by a human being when maimed. It was the inadequate protection given during the early history of the electrical industry and the not infrequent loss of life that caused the Ontario Government to pass a law authorizing the Hydro-Electric Power Commission to prepare Rules and Regulations for the protection of life and property from the hazards arising from the use of electricity.

The Commission was empowered to enforce regulations dealing with the installation, as well as with the design and use of electrical apparatus, the chief object being protection from danger of electrical shock and the reduction of the fire hazard.

The work of the Commission in this regard is divided into two sections, the first deals with the approval of the design and construction of electrical equipment, appliances and materials and work of installing such equipment.

The following Rules and Regulations have been prepared and are in force covering both sections of this work:

1. Rules and Regulations and Specifications for Test and Approval of Electrical Material, Devices and Fittings.

2. Rules and Regulations governing electrical installations for buildings, structures and premises.

The approval of the Hydro-Electric Power Commission of Ontario respecting electrical equipment must be obtained by the manufacturer, by the selling agent, or by some responsible person interested in its disposal to the Public, otherwise it cannot legally be sold or used in Ontario.

The requirements of the Commission are given in the "Specifications for Test and Approval of Electrical Material, Devices and Fittings". In the case of the manufacturers, approval takes the form of a "follow-up-service", the principal purpose of which is to maintain a continuous check upon the quality of approved equipment, in order that the Commission may be assured that the requirements are, at all times, being complied with.

There are two forms of "follow-up" service:

(a) Label service.

(b) Re-examination service.

The follow-up inspection is accomplished by means of periodic tests at the factory by the Laboratory Inspector; by observations of the performance of the approved equipment in service, and by tests at the Laboratories on samples submitted, or upon samples purchased in the open market.

In this way approval has been obtained by about 200 Canadian manufacturers, located almost exclusively in Ontario and Quebec; and by, approximately, 100 United States manufacturers from as far west as Iowa and as far south as Kentucky and Illinois.

In addition to the method of approving equipment as outlined, the Commission's regulations provide for the acceptance and listing of electrical equipment which has been approved by Underwriters'

Laboratories Inc., provided that the manufacturer or submittor continues to have it kept upon the approval records of that organization. A large number of United States manufacturers have availed themselves of this *listing service* and consequently their goods are found on the *approval records* of the Commission.

Up to the time of revision of the Power Commission Act in 1924, the Approval Service lacked the authority which it now has, to regulate by law the sale or other disposal of electrical equipment, as well as its manufacture and use. Now, however, imported devices, particularly those of package and portable types sold by stores direct to consumers are brought under the Rules and Regulations of the Commission.

Since the scope of the Power Commission Act was widened it is noted that the quality of the electrical material offered for sale has been much improved, resulting in the elimination of many substandard devices, jobbers and dealers alike, in their purchases, are complying more closely with the rulings of the Commission with the result that more safe conditions are generally obtaining in electrical installations throughout the Province.

Regulation of the construction of appliances, such as portable lamps, heating devices, including hair-dressing appliances and radio apparatus designed to be connected to power circuits, has made it necessary to develop standards for their inspection and test. A standard specification for portable lamps was put into effect in September, 1924, which has resulted in the elimination, from this Province, of that cheap lightly-insulated cord and those poorly-wired designs which have been the cause of many fires as well as of electrical shocks.

Heating devices were among those appliances to which the attention of the Approval Laboratory was first turned, and as inspection and test of the samples submitted brought out their weaknesses, laboratory requirements were gradually formulated. It is believed that if this service were not in force in Ontario where power is so plentiful and so cheap for domestic use, the fire, and probably the life losses, due to poorly constructed heating appliances would be many times greater than they are today. The Commission's laboratory is frequently called upon to examine devices submitted for approval which, if allowed to be sold in their original condition, would constitute serious life and fire hazards.

It may be pointed out that Ontario was, I believe, the first Province or State on this continent to require a sealed entrance box for electrical installations and to demand that all live parts of switches, rheostats, etc. be entirely enclosed or protected from accidental contact in places where persons without knowledge of electrical apparatus are obliged to operate such equipment. To this end, for example, panelboards are required to be of the dead-front type, and switches controlling motor-operated machines, heaters and like

equipment, are required to be enclosed in sheet metal or else they must be approved snap switches. Some improvements have also been brought about in the construction of small motors for use on machines; exposed terminals have been eliminated; insulation has been improved; brushes better insulated and covered up; and the use of portable cords where machines are essentially of a stationary type is no longer permitted.

Present regulations require that "exposed non-current-carrying metal parts of electrical machinery, equipment, appliances, devices, etc. whether portable or not, operating at potentials exceeding 150 volts", shall be grounded. It is further required that "for potentials *below* 150 volts such metal parts of permanently located equipment, and, wherever practicable, of portable equipment must be grounded if, due to local conditions, there is danger of leakage of current or of electric shock". I quote from the Rules and Regulations under the heading "Grounding". These requirements are kept in mind in the approval inspection of new equipment and the re-inspection of equipment already listed. At the present time, a specification covering devices equipped with smal motors is in course of preparation and it is proposed that portable electric tools and kindred appliances shall be provided with a third conductor by means of which the frame of the appliance may be permanently grounded and danger of shock to the operator thereby largely removed. Portable washing machines are also used in places which, for want of a better term, are called "damp locations" and are, therefore, considered hazardous from an electrical standpoint. Some five years ago, a minimum safety standard applicable to these machines was adopted by the Commission, in which provision was made for safe-guarding the user by thoroughly enclosing the electrical parts and doubly insulating the motor from the metal framework. This, to a large extent, has eliminated the shock hazard, but the next development in the improvement of the washing machine will be the requirement of a third or grounding conductor in the portable cord.

At one time, as many may recall, there were made and sold in this Province, fuses of the so-called "link" type which could be re-fused very readily with almost anything in the shape of metal, thus entirely defeating the purpose for which such electrical "safety valves" are designed. These fuses were banned in favor of the standard enclosed plug and cartridge types, and the latter, though at first not refillable, have since been so designed that they can be refilled and used many times. Many designs submitted failed to meet the standard tests and so were not allowed to be sold or used; the consumer is thus in Ontario protected from the poor substitutes which, at one time, were widely distributed throughout the Province. The fact that these plug fuses, and the refills for the cartridge fuses are comparatively cheap, should be an in-

ducement to prevent anyone from attempting to substitute a link of excessive current carrying capacity at the risk of starting a fire with the possibility of a considerable fire loss, even if no lives are endangered.

The field force of the Electrical Inspection Department is that section of the Commission's organiation which is entrusted with the enforcement of the "Rules and Regulations governing electrical installations for buildings, structures and premises," at potentials of from 10 to 5000 volts. These rules do not cover wired telegraph, telephone and signalling systems, or car wiring; neither do they apply to central and substations designed and used for public supply.

The Department is under the direction of the Chief Electrical Inspector and covers the whole Province with about twenty-five separate districts, each in charge of a local inspector, some of whom have a number of assistants. There are two general classes of inspection carried on, the *ordinary inspection* of all new individual installations, for which separate permits are issued; and the *special inspection* in manufacturing establishments and institutions for which annual permits are issued. This latter facilitates necessary changes being made and entitles the holder of such permit to one inspection per month. In order to obtain the *annual permit* it is required that one of the regular employees be properly qualified to carry out any necessary repairs, alterations and extensions desired by the owner in his electrical installation.

In addition to the rules governing inspection of the physical features of, and changes in electrical installations, there is in the Commission's rules a section covering maintenance and operation for the guidance chiefly of those in charge of the operation of electrical plant; any deviation from the safety requirements of this section may be reported by the inspector and the owner required to put his installation in safe condition.

The formulation of rules for installation work and specifications for approval of equipment is entrusted to two Committees; the Rules and Regulations Committee, under the chairmanship of the Chief Electrical Inspector, and the Approvals Committee under that of the Laboratory Engineer. Included in the personnel of each Committee, in addition to representatives of the Commission, are others appointed at the request of the Commission by various interested bodies, so that all branches of the industry are given a voice in the preparation of the rules and the specifications. After agreement has been reached in committee respecting the form which rules or specifications shall take, they are then submitted for approval to the Commission and finally to the Lieutenant-Governor-in-Council before they become law.

With regard to accident prevention, it may be said that the Commission from the time when power was first supplied, has been deeply

interested in such work. Up to 1917 the Commission carried out accident prevention work as an ordinary part of the duties of the various Departments, but during 1916, investigations were carried out and it was found that it would be an advantage to have this work carried out in an organized manner and by separate Accident Prevention Department.

One of the most important functions of this Department is to carry out investigation and research in Accident Prevention and very close contact is kept with the work of other Public Utilities on this continent. Such investigations are also carried on by Public Utilities in Great Britain, the United States France, Belgium and Australia. It is hoped that in this manner while giving the benefit of our experience to others, we shall be able to gain by their experience and so save much unnecessary effort and expense.

Well realizing that one of the major hazards in electrical work is the danger of electrical shock, a most comprehensive and exact investigation into the question of resuscitation from electrical shock has been carried out during the last ten years. A complete investigation has been made of all information printed in English on the subject, as well as some in foreign languages; and, with the co-operation of the Medical Department of the University of Toronto, original research has been carried out on the subject of electrical shock and resuscitation.

Another function of the Department is to keep an accurate record of all accidents that happen to employees of the Commission; these are classified, carefully analysed and deductions made from them. Every accident at all serious in its nature, is thoroughly investigated, the foreman in charge of the work being required to make a very complete and analytical report in connection with the accident. A beneficial psychological result comes from the making of these reports, because, for one thing, the foreman has to advise as to what he considers to be the real cause of the accident and how such an occurrence can be prevented in the future.

From a study of the following report it will be noted that accidents which are chargeable to "Electrical Current" are low both in frequency and severity, being only 2.3 per cent and 5.6 per cent. respectively, although responsible for two of the three fatals occurring during the year. The accidents due to "Slipping, Tripping and Falling", are responsible for 10.1 per cent. of all accidents and 25.7 per cent. of all lost time. Those due to "Handling Tools" cause 19.7 per cent. of all accidents and 9.8 per cent. of all lost time, while those accidents chargeable to "Handling Material" are responsible for 21.5 per cent. of all the accidents and 12.8 per cent. of all lost time, thus showing that a public utility in general has the same variety of accidents as one would ordinarily expect to find in any industry:

ACCIDENT REPORT FOR YEAR ENDING OCTOBER 31st, 1925.

Cause No.	Cause	Number of Accidents		Time Lost Days	
		Per cent.		Per cent.	
1	Overcome by Gas or Heat...	...		...	
2	Miscellaneous............	1.5		.9	
3	Altercations..............	...		...	
4	Explosions...............	.5		...	
5	Doors or Windows—"Hit by"	.6		...	
6	Stepping on nail or any sharp object................	16.4		2.9	
7	Machinery in Motion......	2.4		4.6	
8	Lamp Breaking...........	...		...	
9	Injured by Animal.........	...		...	
10	Colliding with obstruction...	2.3		.4	
11	Foreign substance in eye....	10.2		2.	
12	Acid, solder compound......	.2		...	
13	Wagon, auto or other conveyance...............	1.6		1.2	
14	Struck by falling body......	10.		19.3	
15	Electric current...........	2.3		5.6	
16	Slipping, Tripping and falling	10.1		25.7	
17	Handling tools............	19.7		9.8	
18	Handling material.........	21.5		12.8	
19	Use of dynamite and other explosives.............	...		...	
20	Poisoning or injury by gas or vapor.................	...		.2	
21	Drowning or other water accidents..............	...		...	
22	Collapse of earth, building, etc.....................	.7		14.6	
	Total Number..........	1537	2156 in 1924	6845.5	10959.4 in 1924
	Average per month......	2761	3358 " "		

Number of Accidents per 1,000 full time workers—556.
Days lost time per 1,000 full time workers—2,478.

The method of carrying out accident prevention work is, in the main, advisory and not executive. Close contact is maintained with the Engineering departments and in general an effort is made to inculcate a

realization of the fact that a design which is not safe to install, operate or maintain is poor engineering and very poor economy.

During construction work, representatives of the Department go out into the field and regular conferences are held with the superintendents and engineers, when discussion of accidents, hazards and methods of prevention takes place. These conferences have been very successful and have undoubtedly resulted in considerable reduction in time lost through accident. Many useful devices, plans and methods developed as a result of such gatherings have become a regular matter of routine and are now hardly looked upon as a matter of accident prevention at all. After the project is complete or has been partly completed, a careful survey and reports are made so as to ensure that no hazard has been overlooked.

The major part of the Commission's accident prevention work has been connected with the Operating Department, and since the members of this Department are, in general, on a more permanent basis of employment than those of the Construction Department, it is possible to carry out a plan that is cumulative in its effect. A representative of the Accident Prevention Department periodically visits each group of men in the Operating department, when talks are given on safe methods and discussions of operating rules are held; the men are also trained and examined in the work of resuscitation from electrical shock, thus a close contact is maintained with the men and the reduction of accidents and loss of time have been very satisfactory.

The Commission has taken the rates established by the Workmen's Compensation Board as a basis and has applied them to its own various conditions. A careful account has been kept of the costs of all accidents. During the years 1924 and 1925, these costs have for each year been lower than the amounts set up according to the Workmen's Compensation Board, by approximately $91,000. The cost of carrying out the accident prevention work for each year has been $19,000. The Commission fully realizes that the rates set by the Workmen's Compensation Board are as low as they are because of Accident Prevention being carried out in those Utilities in Schedule 1.

Though the financial results are satisfactory, a still more important phase is apparent, namely, the saving of human life and the reduction in the number of maimed. To be successful the work of accident prevention must be part of a general policy, but even then only will success be assured if the plans receive the hearty co-operation of the executive and of the employees generally.

Prevention of accidents is, after all, largely, an individual problem and can only be successfully solved by careful analyses of the essential conditions, attention to safe design and construction, and the efficient enforcement of carefully prepared rules.

The human element is ever present and to be effective in accident prevention the staff must know that

the executives are in earnest and thoroughly sympathetic. The organizations you represent can, as I believe they do, render the public substantial service along the lines which I have endeavoured briefly to review.

I might say that the results, so far as the Hydro Electric Power Commission of Ontario are concerned have been very gratifying. We believe that the work established in the department of the Commission has been fully repaid by the excellent work that it has done in the saving of life and the reduction of accidents and lost time, so far as the Hydro-Electric Power Commission is concerned.

I thank you, gentlemen, for this opportunity of presenting the work done in accident prevention by the Commission, and I am glad to say further, that this is spreading out to other provinces, where it will prevent or minimize the accidents which have happened in the past in connection with electrical shock and fatalities from the same. Again I thank you.

Thought in its Bearing on Accident Prevention

By Wills Maclachlan

(A paper presented before the Accident Prevention Conference of the New England Division, N.E.L.A. Boston, Mass., April 23, 1926.)

"TO recognize one's ignorance of unknowable things is mental health and to be ignorant of knowable things is sickness. Only by grieving over ignorance of knowable things are we in mental health. The wise man is wise because he understands his ignorance and is grieved over it."—*Loatzu.*

It was with distinct pleasure that I accepted Mr. Moses' invitation to present a subject to you today. I have, for a number of years, followed the work that has been carried on in the New England Section; first by Mr. Moses and now associated with him, Mr. Packard and all of you. Knowing full well the excellent work that you have carried on in this district, I take it as a distinct honour to be invited to come and discuss with you for a short time, a subject which has recently been running through my mind. Accident Prevention work as we now know it, had its inception about fifteen years ago and was nationally recognized in the Public Utility field about twelve years ago. Quite naturally, the first work was along the line of what might be called Engineering Revision. The properties were carefully inspected, guards placed where needed, warning signs placed, various devices

and appliances developed to take care of the major hazards. It was then found that although these material corrections to a certain extent reduced the number of accidents, yet rules were necessary and Rule Books were developed to take care of some of the hazards. The earlier types of Rule Books being for the most part a series of "Don'ts" have given place to more recent types in which the positive appeal is used, emphasizing definite instructions as to "How to do things". Coming along in the development of the work, we find standardization in connection with various types of appliances and detailed specifications prepared and developed, such as those covering Rubber Gloves and Linemen's Belts. All of these appliances and various developments have been useful and are necessary but it has struck me that these are for the most part but the outward evidences of something that is more basic. If we are really to take our work seriously and endeavour to prevent all possible accidents, we cannot wholly depend upon these materialistic agencies.

The average person does not realize that the method of thought at the present time has been an accumulation of developments coming down through the ages. It was a Greek stone-cutter, living about 450 B.C. who first developed the then rather novel theory that it would be well for men to use their own common sense and analyze their thoughts by introspection, rather than accept the Fairy Tales of Greek Mythology. ("The proper study of mankind is man.") Today we take it for granted that it is well to analyze the facts pertaining to a subject if we would get at the heart of the matter, but in carrying out this method of thought, few of us realize that we are really the disciples of Socrates; so if time permitted, one could come down through the ages and see the advance in the method of thought that has come from those individuals who did not accept unchallenged, the method of thought of their age but asked: "Is it true?" "Is it logical?" "Is it just?" and so on, building that mighty cathedral of human thought and understanding. In tracing this through the ages, one is impressed that the development of ideas came for the most part from men of quiet study and not from men of the spectacular views that caught the eye of the population. Often in our own day the development of ideas is found to permeate through the whole nation before it flashes out in the newspaper as a headline. The work of Luther and Erasmus will last, when knowledge of the work of Napoleon is almost forgotten.

Up until approximately the middle of the Eighteenth Century, the development of thought and the development of civilization were extremely slow. Transportation on land in some months of the year was practically impossible, excepting on horseback. The industries were carried on for the most part as handicrafts in the homes; the city as we now know it, did not exist. Then about 150 years ago, the idea of the use of steam was developed and the machine began

to appear. Factories developed and a man instead of making a whole chair, made at first a part of the chair and then later only carried out one operation on that part. This industrial era, which started 150 years ago and in which we are living today, has developed almost a machine civilization in which man has hardly found himself and has as yet not adapted his thoughts to meet the conditions. In the last twenty-five years the rapidly developing industrial life has brought more and more to one's notice, the cost of the benefits of this industrial era and, although the development of the materialistic side of life has gone on in leaps and bounds, man's mental and social development, which is always slow, has not changed to a great extent on the average, in any thing like the same proportion as the development of the materialistic side.

What are the costs of the benefits of the industrial age? Routine asks for many, without the satisfaction of creating. A strain on a nervous constutution as yet undeveloped to meet the strain. These, together with many others are receiving recognition and attention to a more or less extent. There is, however, one that is of particular interest to us, i.e., Industrial Accidents. During the pre-industrial era, many of our present factory and plant conditions, machines, and occupations, did not exist. The hazards and the resulting accidents have developed with industry and with the speeding up of the life of the age.

Under the older types of civilization, a man usually followed out the trade or profession that had been carried out by his forbears through some generations and in carrying out this trade, habits were developed which were part and parcel of the trade itself. One has only to think of the effect of habit on present life to find that it is only by habit that life is possible. If one had to stop to think of each operation during the day's life, it is doubtful if one could successfully get through breakfast before the evening came. You get up in the morning and dress almost unthinkingly. You certainly put on the same shoe first in the morning and lace that shoe in the usual way, but if you stopped to think and direct your actions as to how to do it, it would be more difficult and much slower than if you let habit carry you through. Suppose you go into your own house in the dark, you will walk round perfectly confident that you will not collide with the furniture; you will possibly run up stairs in the dark, but if you try to think your way round your house or if you try to think how to run up stairs, you will certainly collide with furniture and trip on the stairs. Habit makes possible the ease with which we get through a great number of life's routine duties. Psychologists tell us that habit is formed by doing the same thing in the same way a number of times, which we all know to be true from actual experience.

In looking into the root causes of accidents, we find that inattention is possibly one of the major causes. You may call it carelessness or thoughtlessness, if you will, but to my mind the word inattention is

possibly more exact. The mind is usually thinking of other things than the work in hand. One of the most difficult things to do is to maintain attention in doing routine work over any considerable period of time. Would it not be possible to methodically develop in workmen a good habit of doing the work and in this way depend upon habit to carry the workmen through the period of inattention?

As an example of this, let us take the matter of training in resuscitation. Some of us who have been training men in resuscitation over now a considerable number of years, have found it of advantage to have the men practice resuscitation in a very definite and exact way and to have them carry out the practice twice a month. In doing this we are endeavouring to develop a definite habit of carrying out resuscitation, so that in the time of excitement at an accident, when it is quite possible that men will "lose their heads" and become excited, the habit that has been developed will carry them through and resuscitation will be carried out as it is required. This theory has been demonstrated as being of practical and inestimable value on a number of occasions, when the saving of life was the result.

One might ask: "Why not develop the intelligence by teaching, instead of developing habit by training?" A person may know everything possible about the theory of an automobile; he may know perfectly the theory of driving a car but if he has not driven a car a great number of times, and has not developed a habit of safe driving in an emergency in the traffic of today, he is very likely to be responsible for a bad accident. In many operations there must be developed the habit of such co-ordination of muscle and mind as to appear almost automatic. I would put forward to you as something to take seriously, the advisability of developing an exact habit in workmen, particularly in connection with those routine jobs that may have a hazard in them and in those jobs where the hazard is extremely high. I have particular reference to working on live primary lines and asking for, receiving and returning a clearance, to mention only two instances.

In dealing with the executive and supervisory forces, accident prevention should be made part of the mental aspect. In the design of a machine or a plant the hazards of operation and maintenance should be taken into consideration and not left to be corrected by guards and special rules after the construction is completed. To be really effective, the prevention of accidents must be a regular part of the operation of the utility. The idea must be as much a part of the policy of the organization as any other important matter. This desirable result can only be achieved from within the organization, by clear and effective thinking and planning on the part of those responsible.

To a great number of people, the printed page is sacro-sanct. In this day of thousands of printing presses, this idea should certainly be challenged to a greater extent than in any day in the past and it is only by thinking for one's self and chal-

lenging to a certain extent at least, the printed ideas, that one can hope to advance in the work in hand. Advance in any work is never obtained through the mere collection of facts. Most of us have yards of shelves of information written on the subject of Accident Prevention and yet it is not from this source alone that advance can be made. I find that the last Volume of the Proceedings of the National Safety Council contains over 1,100 pages and I think this admirable Council has been distributing these tomes yearly for the last fourteen years. Some seem to think that by looking up in some volume of these Proceedings and reading a description of how to carry out Accident Prevention in a plant, one can simply take the plan literally and apply it in one's own plant. This I feel, however, is rather a careless method to pursue. It is simply the idea that store clothes are just as effective as tailor-made ones. I suppose if one were of exactly the same dimensions as the model for which the clothes were made, the clothes would fit perfectly but it is usually found that one is not exactly of the same dimensions, even as it is found that your plant is not exactly similar to the plant for which the plan was designed and although the plan worked splendidly in the plant for which it was designed, yet it will work out very indifferently in the plant which you have under consideration. To be successful, therefore, in carrying out Accident Prevention, original thinking is absolutely essential. I would be the last one to criticize the collection of facts and the collection of all the information possible on the subject, but yet after that collection is complete, your real work has to commence and that work depends upon your own original thinking. Even this is not enough, because the thinking must be effective. The most plausible theoretical plan may be developed but it must be practical and must be effective to be of real service.

Any advance in Accident Prevention, depends upon you men. You cannot wait until somebody else has figured it out, particularly in the public utility. We have not a long history to go back on, for precedent, for plans that have been tried out over a period of years, so all advance will have to depend upon the thinking man in the industry. This thinking must be original and effective and it most certainly can, be developed. The reading of books written possibly on abstract subjects' or possibly in the form of fiction' by the great thinkers and leaders of all ages, as is we all know, of great value in developing mental ability as well as being a delightful recreation.

How far have we gone in Accident Prevention? To a great extent we know the general causes of the accidents in our industry. Of the plant and equipment, we know most of the weak spots and have either guarded them or have the matter in hand. The training of the personnel is receiving attention and we have at least sown the idea that it is certainly cheaper and more humane to prevent an accident than to pay the cost of the accident. Possibly, by the development of the

idea of habit, we can overcome some of those accidents that have been worrying us, viz: Those that we have charged to carelessness or inattention. Careful analysis of the work in hand is certainly needed; this particularly in connection with new forms of apparatus and appliances put forward and new schemes of committees and what not, to prevent accidents. Careful analysis of the individual problem of each one of us is needed. After these careful analyses, unbiased and fearless deductions should be made and carried out and then put into effect and tried out and modified where need be.

As to the future of Accident Prevention work, it is my feeling that more advance will come from clear and effective thinking, than by any radical haphazard change. Much as has been the success of the development of the material side of Accident Prevention by guards, special appliances and design, yet I feel that a far greater advance shall be made by attention to the mental side of the problem. It is on "that stuff of which dreams are made" that I pin my faith, rather than on material agencies.

Let the employees of an organization from President to office boy from Chief Engineer to groundman, grasp fully the idea that economically and humanely, accidents are an acknowledgment of failure and entail a terrific loss in money and suffering, and you need worry very little for the result. It is no easy task and is one that is never finished but the dividends are low accident costs and many lives and homes protected to enjoy those many benefits of our industrial era.

> "The mind is the man. If that be kept pure, a man signifies somewhat; if not, I would fain see what difference there is betwixt him and a beast. He has only some activity to do some more mischief."
>
> —*Cromwell.*

Application of Hydro-Electric Power to Farm Work

Article No. I.

THE subject of our article for this issue is the installation on the farm of Mr. S. A. Davis, in the Woodbridge Rural Power District. This service is taken under Class 3, the rate being service charge $3.85 per month, the consumption charge 5 cents for the first 42 kilowatt hours per month, and 2 cents for the balance, with prompt payment discount of 10 per cent.

The installation on this farm consists of: lighting about 1200 watts, one 3 horsepower motor, one ¼ horsepower motor and one table grill 750 watts, total 4374 watts.

Mr. Davis is careful in his uses of the service but does all of the work that he wishes, with the result that the consumption for the four month period, December 1st, 1925, to March 31st, 1926, was 135 kilowatt hours, with a net bill for this period of $18.90. It is to be noted that careful uses resulted in his not getting into the second rate.

The actual work done on the place as given by him, was: chopping about 100 bags of grain; the uses of the saw shown in Fig. I, for ripping wood for making whippletrees and wagon-tongues,etc.; separating the cream ten minutes each

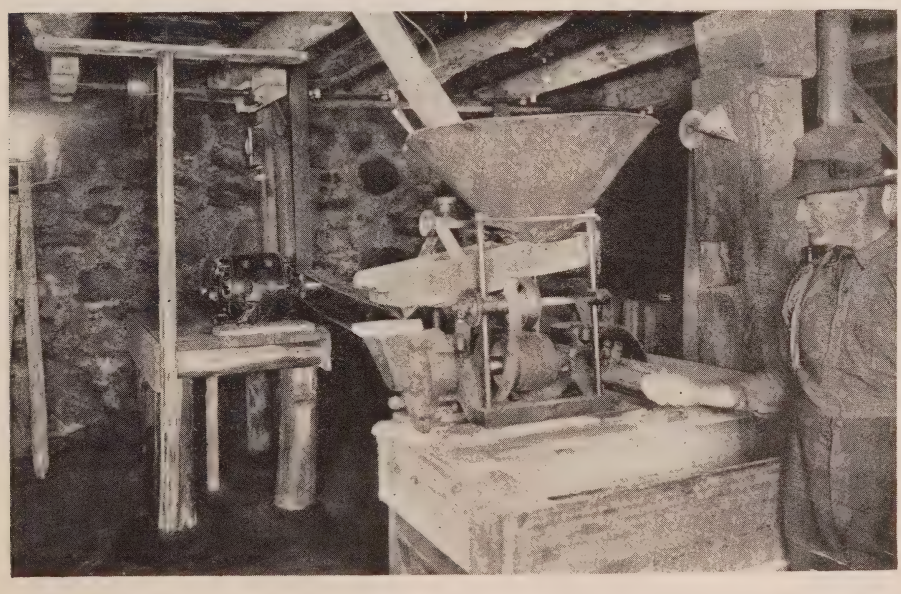


Fig. 1. Electric power installation. Motor (3 h.p.) drives chopper, saw and line shaft, the latter driving line shaft in grannery and barn for fanning mill and cutting box.

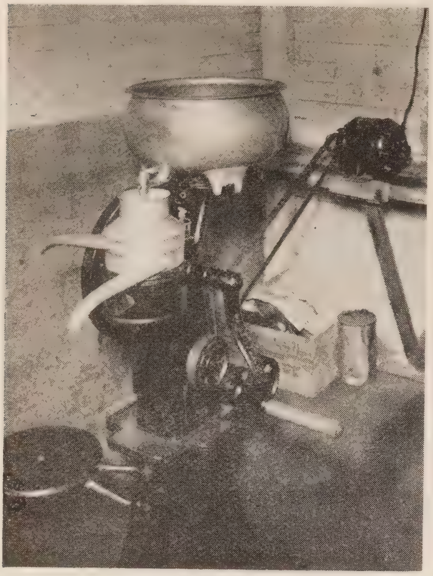


Fig. 2. Installation in dairy. Cream seperator driven by ½ h.p. motor.

time, twice per day, and the cleaning of all the grain that was sold for seed and used by himself for seed. The table grill was used occasionally for boiling a kettle, making of toast and frying of chops or eggs. Liberal use was made of the light when needed.

The four cuts shown are interesting. Three are electrical installations and the equipment driven by the motors. The fourth is an ingenious device in the form of an elevator which he was obliged to build for his use some years ago when troubled with sciatica all one winter.

Fig. 1 shows motor, chopper, saw and line shaft, the latter providing the drive to a line shaft in the granary and barn, the uses in the upper part of the barn being fanning-mill and cutting-box for cutting straw for feed or bedding.

Fig. 2 shows the installation in the dairy. The one-quarter horsepower motor provides the drive for the cream separator, and Mr. Davis is strong in his expression that this particular use is worth what it costs for the whole of his service.

Fig. 3 shows the adaptation of the hanging coal oil lamp shade to an electric fixture in the living-room.

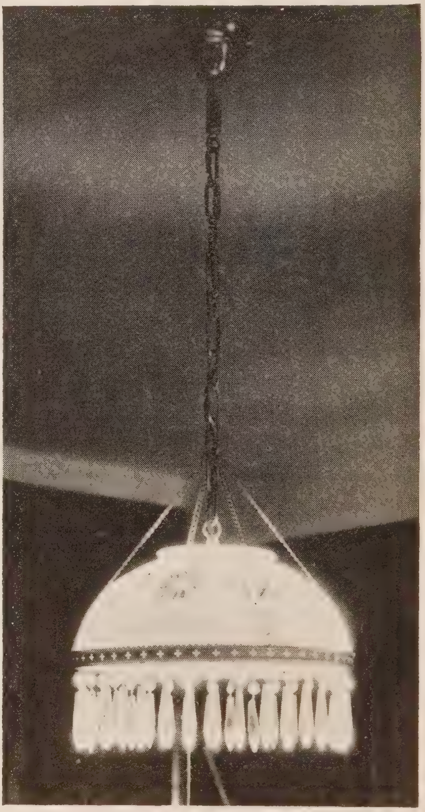


Fig. 3. Adaption of hanging oil lamp shade to electric fixture.

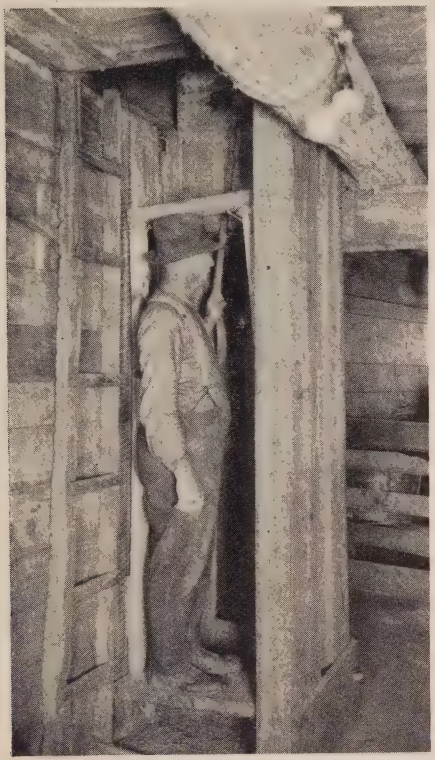


Fig. 4. Hand operated elevator.

The elevator which Mr. Davis ingeniously devised and referred to above is shown in Fig. 4. A counterweight assists in making the lift, a slight pull on the rope being sufficient to complete it. When not in use, the counterweight is held in place by a stop strip pushed into place below the bottom of it, leaving the elevator on the stable floor.

Eugenia Hydro-Electric Association

The fifth Annual Meeting of the Eugenia Hydro Electric Association was held in Hanover on Wednesday June 9th, the programme of the meeting being as follows:—

MORNING SESSION.

10 a.m.—Meeting of Executive.

11 a.m.—General meeting of Association.
Minutes of previous meeting and treasurer's report. Election of Officers for 1926-7.
Arranging matters from municipalities for afternoon meeting.

12 a.m.—Luncheon—Mr. Patterson, of Owen Sound, entertainer.

AFTERNOON SESSION.

1.30 p.m.—President—Opening.

1.45 p.m.—Matters for discussion arranged from Morning Session.

2.15 p.m.—Address: Mr. Magrath, Chairman of Hydro Electric Power Commission of Ontario, or representative.

3 p.m. —H. E. P. C. of Ontario Representatives.

3.30 p.m.—Recreation Period—Mr. Patterson.

3.45 p.m.—Sales Promotion — Mr. Campbell, Wingham.

4.15 p.m.—Resolutions — Open discussion on matters brought forward by delegates.

In the absence of the Chairman, who was unable to be present, Commissioner C. A. Maguire gave a most instructive address at the luncheon on the "Chicago Steal" of Great Lakes waters. Mr. Maguire also addressed the afternoon meeting on general matters relating to the operation of the Commission and the municipalities, in the distribution of electrical energy throughout the Province.

Engineers of the Commission were present and discussed with the municipal representatives, matters of local interest. The rate schedule recently authorized by the Commission for resale rates to consumers was explained, as well as power costs, and the details of the operation for the past year of the Georgian Bay System, of which the Eugenia Division is a part.

The Meeting was most harmonious in every respect, and all of last year's officers were re-elected for the coming year.

Think

The following is from the pen of Fred. W. Johnston, Managing Director of the Citizens Safety Committee, Philadelphia. After reading this any driver cannot help but be touched and will, no doubt, be impressed by the necessity of exercising care, and that the picture drawn will remain with him during the rest of his life.

THINK! DRIVER, THINK!

A wave of the hand, a kiss blown on the breeze from the sweetest little pal in all the world.

I stood for some moments watching her, a chubby little figure in blue and white, an extremely important little person on her way to school.

And then she turned the corner.

It must have been about four o'clock—my mind has been sort of deadened since—that the boss sent for me. "Bob," said he, laying his hand on my shoulder, "there's been an accident and you'd better hurry up to the house."

Well, there isn't much more to tell. That little pal of mine—she—she wasn't at the window, watching for me as usual. For an instant I faltered; it just seemed as though something within me went dead, and I had to fight for breath.

In a little time I went out to the gate, just as I had that very morning. And I looked down the street as best I could. Right over there, a short block away, was where she turned the corner—and passed forever out of my life.

Today, it was my little girl; tomorrow, or next day, it will be some other little pal quite as dear. And so on, and on, until the conscience of men shall cry a halt to this passion for fast driving in localities where danger, obvious danger, stares drivers plumb in the eye.

Can more be said?

The Engineer and Liberal Education

By Albert W. Smith. Dean Emeritus, Sibley College, Cornell University, Ithaca, N.Y.

THE development of engineering in the past fifty years has resulted in ever-increasing demands upon the engineer. Formerly a man with a mechanical bent, if he had also a native gift for finance and commercial dealing, might become a successful manufacturer of something that the world would pay for; or, having a turn for invention, he might develop schemes to substitute for human labor power-driven machines like looms or self-binding reapers. Or, with other mental or imaginative inheritance, he might design and build steam engines or other elements of power plants. These things were done with comparatively slight training in mathematics and physics and chemistry; in fact, most of them were done by "rule of thumb" methods; though there were a few men with rare inheritance, like Professor Sweet and Mr. George H. Corliss who didn't seem to need to learn of nature's laws—whose thought seemed to spring up full-armed.

But in modern engineering all is changed; the problems have grown more and more complex; material agencies unknown until recently are at the hand of the modern engineer, who must know how to use them; the field of engineering knowledge broadens at an accelerated rate, and the engineer must either know or be trained to find out all facts upon which his work depends. In fact, as Mr. Walter Kerr once said of his organization, the modern engineer should be ready to do whatever his clients need to have done. As a result of these changes, those who survive in the struggle for eminence in engineering today are disciplined thinkers, with trained judgment, accustomed to look at facts squarely without colored lights. and their conclusions are usually sound. The modern world has found out these facts, and more and more is calling in engineers to solve its difficult problems. This call came especially often during the Great War, when problems unprecedented in number and complexity demanded solution. The successful results of this movement point to a future in which engineers will become increasingly useful outside of their profession.

A secondary result of this movement is to demand of the engineer that he shall be able to meet those with whom he is associated in his extra-professional activities—financiers, politicians, lawyers, doctors, and others—on their own plane of culture, in order that in off moments he shall be able to respond to their enthusiasms. This ability would increase his influence and power for effective accomplishment, and his enjoyment of life.

Engineers often express regret that they missed college training; or, if they have technical degrees, that they did not also take a general

course leading to the A.B. degree. They speak as if the doors of culture were closed to them; whereas they are really wide open.

Practically all subjects that make up courses in arts and sciences of the colleges and universities are treated in books by able specialists; almost all great books that were formerly locked up in other languages for the man of one tongue, are now available in excellent English translations, published at reasonable prices. The great stories and poems of the world, the most fruitful thought, the records of great deeds and of noble lives, are all in the libraries and the bookstores; he who reaches out for them and reads them—following his enthusiasms—will eventually become a cultured man.

Every able engineer, even as other men, is apt to waste time left over from his profession and his recreations; this waste could be applied to acquiring a liberal education. The first requirement is to form the reading habit. One way to do this is to install a bedside table large enough to hold a reading lamp and a couple of books. One seldom forgets to go to bed; and thus each day the suggestion to read comes at a time when there is little reason for postponement; moreover there is great mental refreshment in diverting for a time the thoughts of the day into other channels; the wrinkles of worry are smoothed out, distractions cease, and with body at rest, and brain clear, one can read with acute understanding and keen enjoyment until drowsiness sets a limit, and sound sleep follows the snapping off of the lamp. One awakens next morning one step farther along the road to culture, and this road grows pleasanter with each step.

If the bedside reading table is not feasible, there are other ways to found the arts college for one student: A reading chair in a quiet corner with an arm broad enough to hold a book, ready at any time to carry on the educational process. There should also be several books within reach, for one should have two, or preferably several, books in the reading mill at a time. Then if one author fails to hold up drooping eyelids, another with greater thrill should come to postpone bedtime.

Then, too, it is most fortunate that almost all of the world's great books are published in small volumes; the kind that slip into the side coat pocket without bulging. No engineer's pocket should ever lack such filling; for, if he is held at a railway junction or elsewhere, with no professional activity possible, the book comes out and the college is at once in session. This is true on trains—local or transcontinental—and in hotels, and it helps to fill in all time intervals that might otherwise be devoted desperately to dull portions of newspapers and magazines.

The next question is: "What to read?" Here general lists of books are of little use, for no list would fit more than one man. Every man should make his own list. At a recent gathering of advanced technical students, personal preference was expressed for subjects for non-technical reading; among them were: Norse mythology, economics, history

of religions, history of philosophy and evolution.

There is one important negative direction: Don't read anything that doesn't hold your interest, even if it is recommended by Dr. Eliot; it is as futile as "trying to throw feathers over a barn." But often a dull book becomes interesting as a result of one's own development of mind and heart. It is well, therefore, not to discard dull books, but to lay them aside to be tested later, even many times, perhaps with final success and great gain.

There is a general opinion that one should read every word between the covers of a book. One cannot help following this rule sometimes. But while there are chapters in many books that drive one along in high gear on the road to culture, other chapters are like water in the carburetor. To read only the chapters that count increases the speed toward liberal education and multiplies the enjoyment.

Every real book suggests others worth reading—sometimes many others—and thus the start is the important thing.

He who follows this belated road to culture lacks the inspiration of great teachers, and the keenness of the youthful mind; but he will find inspiration in the great books, and he will have acquired maturity of mind which makes progress sure though the pace is somewhat slower. One man has done most of his life's reading between the ages of fifty and seventy years, and has thus added greatly to his power and enjoyment and has made old age in prospect look attractive and desirable.

The habit of reading, once really acquired, is seldom discontinued. It has the added advantage that it keeps the mind active into age. Some men stop mental growth early, and the rest of their lives is filled with routine and drudgery; if one meets them after many years they tell the same old stories; their mental interests are those of a child. Compare this with the long, fruitful, developing lives of men like Mr. Edison and Justice Oliver Wendell Holmes.

In general—it is time for engineers to stop bewailing the lack of liberal education, and to set about acquiring one.—*Mechanical Engineering.*

At the Wicket of the Cashier

By John T. Bartlett

SOME time after George W. Bixler, of the Public Service Company of Colorado, at Denver, went upstairs to become publicity manager of the company he wrote out for the new man meeting the people who came in to pay their light bills a list of "discount-alibis". Bixler had met the company's customers for years, he had analyzed them until he knew the subject of customer psychology like a book. He compiled a list of the excuses customers late in arriving employed to obtain the discount to which they were not entitled. Then he gave the new man some coaching in handling these people. Here is a portion of the list:

"My pay check was late."

"I work for the city."

"I could not get in."

"I did not get a bill."

"I forgot all about it."

"I have been out of the city."

"I was too sick to come down."

"It was Jewish holiday."

"We had a death in the neighborhood."

"I haven't been late in two years before."

"The bill is so large I feel I'm entitled to it."

"I had no one to leave with baby."

"I carried it around in my pocket, and forgot all about it."

"My baby was sick."

"The landlady was ill and I had to take care of the house."

"I gave it to my son and he carried it away and lost it."

"I know I'm not entitled to it, but I want it anyway."

"I had the smallpox."

"I voted for your franchise, and it's the first favor I've asked."

"I've been on my vacation."

"I am a clergyman."

"There is a mistake in the bill."

If a survey could be taken, it would doubtless be found that electric service customers in other cities average up in their excuses about like Denver. What is the meaning of it all? What can be done about it?

George Bixler followed constructive methods which reduced to logic a tangled situation. Some of Bixler's ideas and methods the correspondent will come to a little later. First, let's get a close-up on some general phases of the disposition of the public to ask for a discount to which they are not entitled. How honest are light customers?

The "same thing here" excuse illustrated this condition. The person using it saw someone up the line, a lady, "stall" for a discount and get it. He did not hear the rather intimate excuse which she used. It was quite humorous, in ways that need not be explained here, when he said, "Same thing here".

Many more women, proportionately, use excuses than men. The woman, as Bixler reasons it, is more sensitive to the small saving and of what she can buy with it. Her conscience in business matters seems warped. With all due gallantry for

the fair sex, and Bixler can sincerely pay as glowing a tribute I believe as anyone, that sex in front of the electric service company window doesn't check up with the men.

Poor people are good payers, and use excuses relatively little. Bixler believes this is primarily because they are not sophisticated and do not guess the opportunity. The well-to-do people figure relatively few. It is the great middle class which uses the alibi method most.

Among races, the Jews and the Irish seem at times to get a little ahead of others. Politicians, and people holding office or working for the city, are a perpetual problem. They seem thoroughly sold on the idea that the official or semi-official nature of their employment should entitle them to the discount. In Denver Italians stand high with the electric service company in respect to the way they meet their bills.

The business experience of the customer, with one exception, seems to have a great deal to do with a person's tendency to use dishonest excuses. The presumption is that they have seen a great deal of business sharp dealing, and practise it when they come to pay up with the light company.

The exception referred to is old people. They are unusually good customers in their respect for the truth. Vixler's explanation is the logical one that they have reached the stage in life where they realize ethical and other values better than others, and the chance to save a few cents in barter for their conscience doesn't appeal to them.

How a Man Wears His Hat.

Back of the wicket, a thinking man develops a "sense" with regard to the honesty or otherwise of the request for the discount. Sometimes, Bixler says, it is indefinable. The way a man wears his hat means a lot to Bixler; manner means a lot, in a great many ways. With a pretty woman it may be in the nature of her smile, or with a man in the haste or the nervousness of his manner. A barber walks up with his hat on the back of his head and begins by boiling in oil the general manager, for alleged "robbery" as he refers to it. He ends up by asking for the discount. There is no question as to the insincerity of his request even before he has made it.

The most common excuse is, "I could not get in". Next comes, "I did not get my bill".

I asked Bixler for some hints on how to handle discount "stalls". It all depends on the individual case, to an extent. Bixler, who is a mighty good story-teller, recounted some interesting incidents.

> A customer in the Jewish quarter paying a bill late asked for the discount, and his justification for the request was that everyone else got it. Pressed for explanation of the request, he said there was a Jewish club in his neighborhood and the members told each other everything. A member had declared to the club that by "stalling" he got the discount.
>
> "When does your club meet again?" Bixler inquired.

"Next Friday," the customer replied.

"Would you like to be able to tell them something about the discount?" asked Bixler.

"Yes," eagerly the club-member leaned forward.

"Tell the bunch," said Bixler, "that you stalled to get a discount and DIDN'T get it.". . . .

The Hebrew paid the full amount, and that he did make the requested report to the club is evidenced by the fact that the members thereafter paid their bills on time.

A landlady who was leaving Denver for California, where she expected to stay permanently, came to Bixler to say good-bye. "Mr. Bixler," she said, "I've stood in front of this wicket hundreds of times and told you lies!"

"I know it," said Bixler without batting an eyelash. "I knew every one."

The woman was astonished. She asked Bixler for an explanation. He explained. To have revealed to her the fact that he knew she was lying would have been a terrible blow to her pride and would probably have made her a secret enemy. He had refrained from doing it.

The sequel came two years later. The woman returned to Denver to live, and became a light company customer. Thereafter, she invariably paid her bills on time. There was never again an excuse.

Bixler's policy the first time or two was to take the customer's honesty for granted, in a large proportion of cases, and heed the request. Another month would come around, again the customer might have an excuse. Bixler developed the faculty of remembering faces and excuses.

"This happened last month, old man," he said on occasions. "You'd better watch yourself next month." And there was enough of suggestion in his glance and the way he said the words to get the idea across.

In one instance, paying a bill which included arrears, a business man customer deducted a discount on the arrears, explaining in the accompanying letter that he had never received a bill. As he was prepared and ready to pay the bill, getting the discount, in case the company had sent it, he felt he was entitled to the discount on the arrears. Yes! perhaps. But the bill which the customer attached to the check was not the bill showing arrears, but the bill he said he had never received. The explanation was plain enough. He had had both bills in front of him. By mistake, the wrong one had been returned.

Bixler met this man, a personal friend, at the latter's office a little later; the customer began to bluff as he had done in his letter. Bixler confronted him with the bill he had actually sent.

"Agnes!" the business man shouted to his stenographer, "you spilled the beans. See what you did!" Agnes began to sob. The atmosphere was hectic for a moment, with the sweat standing out on the business man's forehead. "Yes, I lied," he said. "I'll admit it. Everybody lies to the light company."

"No, they don't," Bixler replied. He smoothed the matter out, told Agnes she might have the undeserved discount to finance a lunch, and left.

The business man remained Bixler's friend, and he has always been an honest light customer since and a worthwhile friend of the company. Over that $1.50 undeserved discount, had the matter been handled tactlessly, the company would have "shown up" a dishonest customer, but would have made him a personal enemy for life. And a light company can't afford to have its community peopled with personal enemies.

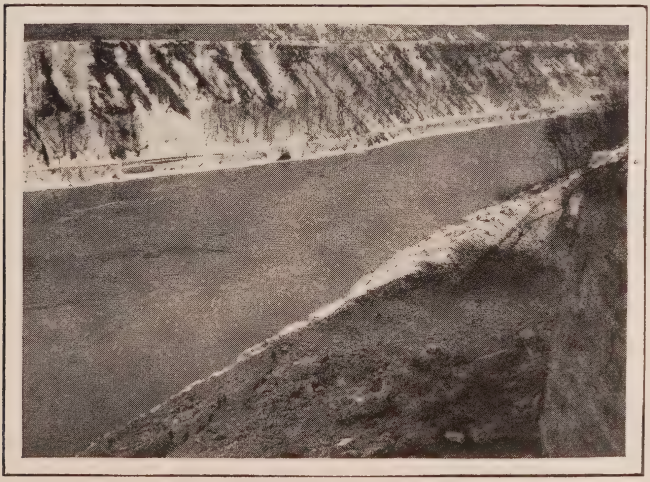
Most customers are honest, some so much so that occasionally they come in and report that there is a mistake in the bill,—it is too low. Investigation reveals that the meter has stopped. But the company doesn't pro rate, when a new meter is installed. The customer is rewarded for his honesty.

What type of man, physically, is best adapted to deal with the public coming in to pay light bills? George Bixler, himself of generous size, believes that large physique is very desirable. The public will take a refusal from his type of man much better than from a small man. His bulk gives authority to his statements, and, perhaps, good nature.

At any rate, where a small man will make the customer feel like reaching in, grabbing the company man by the neck and pulling him out, a large man will cause him to accept the ruling and pay the amount with a degree of philosophy.

The major aspects of the subject involve much more than what can be saved by handling the "stalls-for-discount" in a tactful manner. The man behind the wicket is the point of most frequent contact between the company and its customers. Month after month he meets them. And he has endless possibilities of building good-will, or bad-will.

—*Electric Light and Power.*



Hydro News Items

Central Ontario System

The Hinde & Dauch Co., who are locating at Trenton, expect to have their new factory erected and to be taking power from the Commission by next fall.

* * *

The Bowmanville distribution system is being slightly remodelled in order to separate the lighting load from the power load. The location of the power load is such that this can be done without great expense.

* * *

The Municipality of Whitby has signed a cost contract with this Commission. Up to the present this municipality has been receiving power under the terms of a contract originally made with the old Electric Power Co.

* * *

The Village of Pickering is now installing a street lighting system consisting of 30 - 100 watt street lights and numerous extensions are being made in the Pickering Rural District.

* * *

Ottawa System

A resolution has been received from the Village of Cumberland requesting estimates on a supply of electric power.

* * *

An extension of the Nipean rural district to Stittsville is being planned, work to be started shortly.

* * *

Contracts have been received from the Villages of North Gower and Osgoode and it is very probable that an extension will be built from Manotick this summer to serve these villages. This will probably require the changing of the voltage on the present rural lines out of Ottawa from 4000 to 8000 volts.

* * *

An extension of 3 miles of rural line in the township of Gloucester has been approved.

* * *

Personal Notes

It is with regret we report the illness of Mrs. Magrath, which has necessitated her undergoing an operation at the Royal Victoria Hospital, Montreal. We understand Mrs. Magrath is now progressing favorably and we hope for her speedy recovery.

During the early part of this month, Mr. F. A. Gaby, Chief Engineer, accompanied by Mr. T. H. Hogg, Chief Hydraulic Engineer, and Mr. A. V. Trimble, Construction Engineer, made a trip of inspection of the water powers and development work on the Nipigon River. They visited the site of the Alexandra Development where construction has just been started, the Nipigon Development and Virgin Falls.

* * *

Announcement by the American Institute of Electrical Engineers of officers elected for the year 1926, shows two members of the Commission's staff as included in the list. Among the Managers, who are elected from the membership at large, is Mr. H. C. Don Carlos, Operating Engineer, resulting from the ballot taken early in this year. As Vice-President representing all of Canada, is Mr. W. P. Dobson, Laboratory Engineer, who was elected a year ago, the term of his office being two years.

* * *

At the annual convention of the Canadian Electrical Railway Association which was held at Quebec, June 1st to 4th, and reported to be the most successful convention in the history of the Association, there being 92 per cent. of the Electric Railways of Canada represented, the officers elected for the ensuing year include the following: As Honorary President, Mr. P. W. Ellis, Chairman, Toronto Transportation Commission and Chairman, Toronto Hydro-Electric Commission. As President, Mr. W. R. Robertson, Superintendent of Hydro Radial Operation, Toronto. As member of the Executive Committee, Mr. C. L. Wilson, Superintendent, Toronto District Hydro Radials.

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in May, 1926.

Appliances

Altorfer Bros. Co., Peoria, Ill.

Electric Washing Machines and Wringers. Masco Model 18 E.

A.B.C. Vacuum Cup Model 70, Double A Model 50.

* * * *

Beach Foundry Limited, Ottawa, Ont.

Warming Closet for use with Ranges, Styles E13A and E14A, E50A.

* * * *

Louis Garfinkel & Co., 688 College St., Toronto, Ont.

Curling Tong Heaters, "Rayonnant".

THE IDEAL ELECTRIC & MANUFACTURING CO., Mansfield, Ohio.

Polyphase Motors, Type AA.

* * * *

ARTHUR J. LAYZELL, 334 Yonge St., Toronto.

"Medaco" high frequency generator.

* * * *

THE McCLARY MANUFACTURING CO., London, Ont.

Electric Ranges with "Speediron" metal enclosed units.

* * * *

THE SINGER MANUFACTURING CO. LTD., (Mfr.), Singer, Clydebank, Scotland.

SINGER SEWING MACHINE COMPANY, (Submittor), 149 Broadway, New York, N.Y.

Portable Sewing Machine, Motors, Cat. No. BUK.

* * * *

SOUTHERN ELECTRIC COMPANY, 27 Wilton Square, Toronto.

Combination Air Heater and Grill.

* * * *

THE STEEL TROUGH AND MACHINE COMPANY, LTD., Tweed, Ont.

Electrically - illuminated gasolene pumps and visible measuring tanks.

"The Steel Trough and Machine Company, Ltd."

Motor-operated Water System. "Tweed".

* * * *

*BURTON & ROGERS MFG. CO., 755 Boylston St., Boston, Mass.

Hot cathode argon-gas filled rectifiers.

Marking: Nameplate.

* * * *

Fittings

THE CROUSE HINDS COMPANY OF CANADA, LIMITED, 7 Labatt Ave., Toronto.

Cast-iron conduit fittings. Types C, LB, LL, LR, T, TB, U.

Sheet metal covers for use with these fittings.

Cast-iron conduit fittings, Types A, B, BA, C, CO, COV, CUB, E, F, LB, LF, LL, LR, LBB, LFB, LLB, LRB, LBL, LBR, LFT, LU, LBV, LBVE, T, TA, TB, TL, TR, X, XA, TBE, U, UB, UF, AM, BM, BNM, CM, DF, DM, EM, LFN, LLM, LRM, TM, TBM, TMD, XM.

Obround covers for condulets.

Mogul condulets, Types BC, BEE, BLB, BT, BTB, BU, BUB, BUF, BX.

Obround covers for above mogul condulets.

* * * *

*AURORA STEEL PRODUCTS CO., Aurora, Ill.

Cabinets and Cutout Boxes—sheet metal.

* * * *

*EAGLE ELECTRIC MFG. CO., 38-52 South 8th St., Brooklyn, N.Y.

Ground Clamps for use with 1-in. rigid conduit or less.

Marking: "Eagle" stamped on strap.

* * * *

Switches

*WILCOLATOR CO., THE, 17-23 Nevada St., Newark, N.J.

Temperature regulating appliance.

Marking: "Wilcolator".

*BARBER ELECTRIC MFG. Co., North Attleboro, Mass.

Cartridge Fuse Cutout Bases "B. E.M.Co." Cat. Nos. 2135-30, 2165-30, 2569-30, 2587-30, 2965-30, 2135-60, 2569-60, 2587-60, 2965-30, 2165-60.

* * * *

Portable Lighting Devices

DOMINION MANUFACTURERS LTD., 109 Niagara St., Toronto, Ont.

Portable electric lamps. "Dominion Manufacturers Limited."

* * * *

J. J. GREER & COMPANY, 146 Jarvis St., Toronto, Ont.

Portable electric lamps. "J. J. Greer."

* * * *

THE LESLIE ELECTRIC CO., 74 Grange Ave., Toronto, Ont.

Combination Portable Electric Lamp and Radio Loud Speaker. "W. H. Leslie."

* * * *

THE METAL STUDIOS, LIMITED, 21 Walnut St. N., Hamilton, Ont.

Portable Electric Lamps. "M.S."

* * * *

*These devices are under the Underwriters' Laboratories re-examination or Label Service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

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Mr. C. A. Magrath's Letter of Submittal of the Eighteenth Annual Report of the Hydro-Electric Power Comission of Ontario

To His Honour THE HONOURABLE HARRY COCKSHUTT,

Lieutenant-Governor of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to your Honour the Eighteenth Annual Report of the Hydro-Electric Power Commission of Ontario for the fiscal year ending October 31, 1925.

This Report covers all of the Commission's activities and also embodies the financial statements of the municipal electric utilities operating in conjunction with the various systems of the Commission and supplying electrical service to the people of the Province.

Dealing, as it does, with a multiplicity of activities relating to several electrical systems obtaining power from twenty-one hydro-electrical plants operated by the Commission, supplemented by power purchased from other sources, and recording financial and other data relating to the individual local municipal electric utilities, the Annual Report presents a large amount of statistical information, much of which must, of necessity, be of a summary character.

The financial statements, the statistical data and the general information given, however, are so arranged and presented as to convey a comprehensive outlook on the features of the Commission's operations. Not only does the Report record the progress made during the past year, but it gives, in addition, the cumulative results for the various periods during which operation has been maintained in the respective municipalities.

CONTENTS

Vol. XIII. No. 7

July, 1926

It is not necessary to review here prominent features connected with the operation of the Commission's systems because these are satisfactorily covered in the section of the Report devoted to this subject. It is appropriate to mention, however, that during the past year the operation of all the systems has been carried on very successfully and without serious trouble. The class of equipment provided in the Commission's generating plants and the care with which it has been maintained and operated has enabled power to be continuously supplied throughout the year without a single minute's complete interruption to the Niagara system, the Central Ontario and Trent system and the Georgian Bay system. A few minor troubles have, of course, occurred on the local transmission and distribution systems. The total power generated, and also the peak loads, increased on most of the systems.

The Muskoka system with its generating plants has been incorporated into the Georgian Bay system with beneficial results to all the municipalities supplied by this system. The Thunder Bay system has experienced another remarkable increase in demand for electrical energy. This system operates at an exceptionally high load factor, and in order to aid in providing the stream flow necessary to meet the load conditions, the Commission has completed a dam at Virgin Falls below the outlet of Lake Nipigon.

Cost of Electrical Service Furnished by the Commission

The function of the Commission is not only to use its best endeavours to provide for the people of Ontario, at cost, an adequate and reliable supply of electrical energy, but also to ensure that the cost of that electrical energy to the consumers shall be a minimum. The success that has been attained in the accomplishment of the latter object may be appreciated from the fact that, whereas, according to a recent statement by an accredited authority in the United States,* the average price of electricity to the domestic consumer in the United States, in 1925, was 7.5 cents per kilowatt-hour, the corresponding cost in Ontario, in municipalities served by the Hydro-Electric Power Commission—as shown by the figures given in Statement "D" on page 335 of this Report—was, for 1925, less than 2.1 cents per kilowatt hour. Statement "D" indicates also that

*Electrical World, New York, January 2, 1926.

rates for commercial light and industrial power service in Ontario are similarly low.

Respecting the cost to the ultimate consumer of electrical service furnished to Ontario municipalities by the Commission, the following facts are of interest:

More than eighty per cent. of the electrical energy utilized for domestic service is sold in municipalities where the average charge to consumers of this class is less than two cents per kilowatt-hour.

More than eighty per cent. of the electrical energy utilized for commercial light service is sold in municipalities where the average charge to consumers of this class is less than three cents per kilowatt-hour.

More than seventy per cent. of the electrical power distributed by municipal systems and utilized for power service is sold in municipalities where the average charge to consumers is less than twenty-five dollars per horsepower per year.

In each of the above cases the consumers' cost quoted is inclusive of all charges.

* * *

The following tabulation (Table No. 1) shows the growth in load in the various systems during the year:

Financial Summaries

It will be observed that the financial statements embodied in this Report are presented in two main divisions, namely, a division —Section IX—which deals with the operations of the Commission in the generation, transformation and transmission of electrical energy *to the co-operating municipalities*, and a division—Section X—which deals

DISTRIBUTION OF POWER TO SYSTEMS

20-Minute Peak Horsepower
System Coincident Peaks

System	October 1924	October 1925	December 1924	December 1925
Niagara system and export......	576,510	683,646	651,474	732,306
Georgian Bay system..........	17,009	18,261	17,111	17,544
St. Lawrence system...........	4,998	5,350	5,112	5,963
Rideau system................	2,694	2,533	2,607	2,654
Thunder Bay system...........	34,200	44,086	37,500	49,044
Ottawa system................	13,206	14,260	14,708	15,617
Central Ontario and Trent system.	34,892	37,762	39,222	41,622
Nipissing system..............	2,429	2,500	2,218	2,693
Total....................	685,938	808,398	769,952	867,443

Table No. 1.

with the various operations of the municipalities in the localized distribution of electrical energy *to consumers.*

The cumulative results to date of the operation of the several systems of the Commission as set forth in this Report demonstrate a remarkably healthy financial condition.

The total investment of the Hydro-Electric Power Commission of Ontario in power undertakings and hydro-electric railways is $198,998,979.33, and the investment of the municipalities in distributing systems and other assets is $77,721,093.93, making in power and hydro-electric railway undertakings a total investment of $276,720,073.26.

The following statement (Table No. 2) shows the capital invested in the respective systems and municipal undertakings:—

As usual the Commission is able to report that the revenue obtained from the consumers has been more than sufficient to meet the full cost of generating and transmitting the electrical energy as well as to provide for all operating expenses and the fixed charges of the municipal utility equipments.

The Commission collected from the municipal utilities and other customers, for power sold, a total sum of $18,002,148.96. This sum was appropriated to meet all the necessary fixed charges and to provide for the expenses of operation and administration. After meeting all charges there was left a net surplus of $437,848.25.

The following statement (Table No. 3) summarizes the Commission's collections from municipal hydro-electric utilities and other power customers for the year and shows

Niagara system	$153,792,760.69
Georgian Bay system	5,069,063 87
Muskoka system	
St. Lawrence system	1,040,728.59
Rideau system	1,106,002.20
Thunder Bay system	11,740,641.16
Ottawa system	29,333.48
Central Ontario and Trent system	13,911,894.31
Nipissing system	1,027,720.47
Service buildings, construction plant, stores, etc	2,807,400.40
Hydro-electric railways	8,473,434.16
	$198,998,979.33
Municipalities' distributing systems and other assets (including $7,551,588.70 of municipal sinking fund equity in H.E.P.C. System)—all systems	77,721,093.93
	$276,720,073.26

Table No. 2

how the collections have been appropriated:

balance of $1,700,145.30, and bonds and other investments of $1,095,-

Revenue from municipalities and other power customers		$18,002,148.96
Appropriated as follows:—		
Operation, maintenance, administration, interest and other current expenses	$13,847,466.79	
Reserved for sinking fund, renewal of plant and equipment, and contingencies	3,716,833.92	
		17,564,300.71
Net surplus after providing for all operating expenses and necessary fixed charges		$437,848.25

Table No. 3.

The following (Table No. 4) is a summary of the year's operation of the municipalities which operate under cost contracts with the Commission:

662.92. The total surplus in the municipal books now amounts to $17,952,564.77, in addition to a depreciation reserve and sundry other reserves aggregating $9,856,584.88.

Total revenue collected by the municipalities		$20,419,114.50
Cost of power	$10,661,300.64	
Operation, maintenance and administration	4,352,003.77	
Debenture charges and interest	3,245,661.91	
Depreciation	1,079,870.42	
Total		19,338,836.74
Surplus for the year		$1,080,277.76

The above covers only the municipalities operating under cost contracts with the Commission.

Table No. 4.

The total reserves of the Commission and the municipalities for sinking fund, renewals, contingencies and insurance purposes amount to $46,635,214.19, made up as follows (Table No. 6):

The consolidated balance sheet of the municipal hydro-electric utilities, on page 239, shows a total cash

The following is a brief summary of the principal operations relating to the several systems of the Commission, which are presented in detail in the body of this Report:

Niagara System

The Niagara system embraces all the territory lying between Niagara

RURAL POWER DISTRICTS—OPERATIONS FOR YEAR 1925

	Niagara system	Georgian Bay system	St. Lawrence system	Ottawa system	Central Ontario and Trent system	Totals
	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.
Cost of power as provided to be paid under sec. 23 of Act	171,864.42	7,805.54	4,870.90	1,475.55	6,955.72	192,972.13
Cost of operation, maintenance and administration	136,467.63	3,391.29	1,840.94	2,464.39	4,422.80	148,587.05
Interest	48,631.34	2,908.66	1,673.55	1,314.63	2,226.13	56,754.31
Renewals	40,696.71	1,892.35	1,188.03	1,088.20	1,973.60	46,838,89
Contingencies	10,174.17	473.07	297.01	272.05	....	11,216.30
Sinking fund	18,275.59	1,028.59	551.72	504.43	....	20,360.24
Total expenses	426,109.86	17,499.50	10,422.15	7,119.16	15,578.25	276,728.92
Revenue from customers	510,017.27	19,344.53	10,388.37	6,205.15	20,257.07	566,212.39
Surplus	83,907.41	1,845.03	....	....	4,678.82	....
Deficit	....	....	33.78	914.01	....	....
Net Surplus	....	....	....	....	....	89 483.47

Table No. 5.

Niagara system	$14,179,952.57
Georgian Bay system	988,425.77
St. Lawrence system	258,875.22
Rideau system	121,346.13
Thunder Bay system	195,273.46
Ottawa system	5,341.74
Central Ontario and Trent system	1,849,177.55
Nipissing system	85,582.00
Service buildings, etc.	1,142,090.10
Total reserves on Commission's property	$18,826,064.54
Total reserves of municipalities	27,809,149.65
Total Commission and municipal reserves	$46,635,214.19

Table No. 6.

Falls, Hamilton, and Toronto on the east, and Windsor, Sarnia, and Goderich on the west, served with electrical energy generated at Niagara Falls.

The Commission in this system

has a total capital investment of $153,792,760.69, and accumulated reserves for renewals, sinking fund and contingencies aggregate $14,-179,952.57. The actual cost of power during the year was $60,304.64 less than the amounts of the interim bills and the municipal electric utilities operated with a net surplus of $761,382.39 after providing $921,-887.58 for depreciation. Only five municipalities had actual deficits during the year and these were very small, aggregating $1,933.57. The total revenue of the municipal electric utilities in this system was $17,907,071.14.

There has been a steady increase in the number of customers and in the loads supplied to the municipalities. The seventh unit and the eighth unit at the Queenston-Chippawa generating station were put in operation during the year, and all eight units were operating in October. The ninth generator was installed and put into operation during December, 1925.

A 110,000-volt line was constructed from St. Thomas to Sarnia and a 110,000-volt transformer station was constructed at Sarnia, both of which will be put into operation early in the fiscal year 1926.

Georgian Bay System

During the past year the formation of the Georgian Bay system as originally planned has been completed by the inclusion of the Muskoka system. As now constituted, the combined system serves that portion of the province of Ontario which surrounds the southern end of Georgian Bay and lies to the north of the territory served by the Niagara system. It includes the district surrounding lake Simcoe and embraces all of the counties of Bruce, Grey, and Simcoe, the district of Muskoka, and the northern portions of Huron, Wellington and Ontario counties.

The combined installed capacity of the generating plants serving this system will approximate 22,000 horsepower upon the completion of extensions to the generating plants on the Muskoka river. During the year two new 2,000-horsepower units were installed and placed in operation at the South Falls generating station. At Hanna Chute, about half a mile above the South Falls generating station, a third unit is being installed at a concrete dam now under construction designed to create a head-pond of ample magnitude for the South Falls development. This unit will be operated by remote control from the main station. The Muskoka division of the Georgian Bay system is connected with the Severn, Eugenia and Wasdells divisions by means of a transmission line between the South Falls development and Waubaushene.

The Commission in this system has a total capital investment of $5,069,063.87, and accumulated reserves for renewals, sinking fund and contingencies aggregate $988,-425.77. The actual cost of power during the year was $1,396.40 less than the amounts of the interim bills, and the municipal electric utilities operated with a net surplus of $62,916.49 after providing $43,-987.02 for depreciation. Fifteen

municipalities operated with small losses aggregating $11,547.27. The total revenue of the municipal electric utilities in this system was $927,752.38.

St. Lawrence System

The St. Lawrence system serves the district immediately to the north of the St. Lawrence river between Brockville and Cornwall; the supply of power for the system being purchased from the Cedar Rapids Transmission Company, delivery being made at a point near Cornwall. Service is given to ten municipalities, six rural power districts and two companies.

The Commission in this system has a total capital investment of $1,040,728.59, and accumulated reserves for renewals, sinking fund and contingencies aggregate $258,875.22. The actual cost of power during the year was $3,628.53 less than the amounts of the interim bills and the municipal electric utilities operated with a net surplus of $20,424.58 after providing $6,792.00 for depreciation. Two municipalities in this system had small deficits aggregating $1,681.62. The total revenue of the municipal electric utilities in this system was $203,963.70.

Rideau System

The Rideau system serves the district in the vicinity of Smith's Falls, Perth and Carleton Place. Power is available from two generating plants, one at Carleton Place and the other installed by the Commission at High Falls. Both are situated on the Mississippi river. The Commission also purchases power from the Rideau Power Company of Merrickville. The Carleton Place plant was not in operation during the past year because the capacity of this plant was not required in order to provide the power requirements of the municipalities. The system supplies five municipalities situated between the Ottawa and St. Lawrence rivers, west of Ottawa.

During previous years the Commission sold approximately 500 horsepower to a crushed rock company located between Merrickville and Kemptville. No power was delivered to this company during the year, and as a result less power was sold from the system.

The Commission in this system has a total capital investment of $1,106,002.20, and accumulated reserves for renewals, sinking fund and contingencies aggregate $121,346.13. The actual cost of power during the year was $21,735.20 greater than the amounts of the interim bills. Four municipalities had small deficits for the past year aggregating $2,665.62. The total revenue of the municipal electric utilities in this system was $183,902.04.

Thunder Bay System

The Thunder Bay system during the past year has established another remarkable increase in the demand for electrical energy, and thus has further justified the policy of providing for this district an ample

supply of power "on a scale which would not only encourage pioneer development of the natural resources, but which at the same time would provide for such future supply of power as would stabilize the communities and industries which would become dependent upon power as a prime industrial necessity." The increase in the consumption of power with the corresponding increase in revenue has given to the Thunder Bay system a most satisfactory financial status.

The existing pulp and paper mills, as a result of the acquisition by the companies of new timber limits, are to be greatly enlarged, and to take care of additional power requirements the Commission has found it necessary to plan for an immediate additional development at Alexander Landing, situated one and one-half miles below the present Cameron Falls generating station. The Commission is also making further studies of other sites on the Nipigon river, particularly one at a point above Cameron Falls.

Negotiations which have been carried on with existing companies, together with applications for power already received, make it probable that the demand for power will, by 1932, be for about 150,000 horsepower.

During the past year the average load on the system increased by 10,357 horsepower, and reached a total of 37,612 horsepower. The 20-minute peak load in December, 1925, reached a total of 50,200 horsepower, exceeding that of 1924 by 12,400 horsepower. The peak load of the city of Port Arthur was, for the same period, 27,909 horsepower, an increase of 4,170 horsepower as compared with the corresponding period of the previous year.

During the year units No. 5 and No. 6 were installed and placed in operation at the Cameron Falls generating station, thus, with an installed capacity of 75,000 horsepower, completing this development as originally planned. The dam at Virgin Falls for conserving water by creating storage on lake Nipigon was also completed.

Service was given for the first time during the year to the village of Nipigon and estimates and plans were prepared for a terminal substation and municipal distributing station for the city of Fort William in order to provide for the delivery of power in December, 1926.

The Commission in this system has a total capital investment of $11,740,641.16 and accumulated reserves for renewals and contingencies aggregate $191,525.66. The total revenue of the municipal electric utilities in this system was $701,315.33.

Ottawa System

The Ottawa system comprises the city of Ottawa and the Nepean rural power district. It receives its power from a hydro-electric development on the Ottawa river within the city. It is interesting to note that, although Ottawa enjoys the lowest average cost for electrical energy for domestic service in Ontario, its net surplus after providing $51,379.00 for depreciation was $36,055.12, an amount equal to two-

thirds of the revenue received by the electrical utility of the city for the commercial power service it supplied.

Central Ontario and Trent System

The Central Ontario and Trent system serves the district bordering the north shore of lake Ontario lying between the territory on the west served by the Niagara and Georgian Bay systems and that on the east served by the St. Lawrence and Rideau systems. The nucleus of this system was the group of properties formerly controlled by the Electric Power Company, Limited, and operated by it through the agency of twenty-two subsidiary companies. These properties were all purchased by the province of Ontario on March 1, 1916, and have been operated by the Commission as trustee for the Province since June 1, 1916. Since that date the system has been greatly enlarged in order to meet the constantly growing needs of the district.

Twelve municipalities, ten of which have been connected to the system since the date of purchase, operate their own distribution systems under contracts with the Commission. These municipalities are grouped in what is termed the Trent system. This system also includes certain rural power districts.

The power supply for the Central Ontario and Trent system is obtained from a number of power developments situated on the Trent and Otonabee rivers. The power developments were constructed in conjunction with dams required for navigation purposes. The two new remote control generating plants on the system, situated at Dam No. 8 and Dam No. 9, were in operation throughout the year. Investigations on the possibilities of the Crow river storage basin for increasing the power supply on the Trent river were continued.

For the purpose of financial statements the Nipissing system, referred to below, is included with the Central Ontario and Trent system. The financial results of the operations of the year are very satisfactory. After meeting all operating and maintenance costs, all interest, all sinking fund on that portion of the investment for which sinking fund provision is required, provision for renewals reserve of $145,614.45 and provision for contingencies reserve of $53,992.84, a net surplus of $13,243.52 was available.

It is worthy of note that the total reserves which have been set up out of earnings for the benefit of this system now amount to $1,934,759.55.

Trent System

The twelve municipalities operating their own distribution systems under cost contracts with the Commission in the district known as the Central Ontario and Trent system have been grouped under the above heading. They are served with energy from, and are considered as customers of, the Central Ontario and Trent system. Their combined operation for the year shows a net surplus of $77,910.44 after providing $28,116.00 for depreciation.

Nipissing System

This system comprises the city of North Bay, the town of Powassan and the village of Callander, and was acquired by the Province in 1916, at the same time as the Central Ontario system property, the records of which on the Commission's books include the Nipissing system. The Nipissing system is supplied with power from two hydro-electric developments on the South river, at Nipissing and Bingham Chute.

The North Bay substation was enlarged during the year by the addition of a 750-kv-a, 3-phase transformer, increasing the capacity thereof by approximately 1,000 horsepower.

This year marks the termination of the franchise in North Bay of the original company, which has been carried on by the Commission since this property was taken over. The best method of continuing service to these municipalities in future is being studied. Investigation concerning the conservation and storage of water for operating the generating stations serving this district were also made during the year.

The Annual Report

The Table of Contents, pages xxi and xxii, conveys a good understanding of the scope of the matters dealt with in the Report, to which there is also a comprehensive Index. To those not conversant with the Commission's Reports the following notes will be useful.

In Section II, pages 6 to 48, dealing with the Operation of the Systems, are a number of interesting diagrams showing, graphically, the increase in the loads on the various systems. Tables are also presented showing the amounts of power taken by the various municipalities during the past three years.

The rural distribution work of the Commission has proved of widespread interest and special reference to this is made in Section III on pages 63 to 66. The power distributed to rural districts is, and probably must always be, but a relatively small proportion of the power distributed by the Commission. The supplying of electrical service in rural areas, and especially on the farm, has, however, been of great economic benefit to Ontario. The Provincial grants-in-aid to this work have been of assistance to agricultural activities, and have enabled the Commission to extend transmission lines to many areas which could not otherwise have received the benefits of electrical service.

In Sections IV, V and VI will be found information respecting progress of work on new power developments and on transmission system extensions, together with photographic illustrations.

About two-thirds of the Report is devoted to statistical, financial data which are presented in two Sections, IX and X.

Section IX presents in summary form the financial statements relating to the operations of the Commission in the generation, transformation and transmission of electrical energy to the co-operating municipalities. It is introduced by an important explanatory statement

which appears on pages 125 to 129, to which special reference should be made.

Section X presents in summary form the financial statements relating to the operations of the municipalities in the localized distribution of electrical energy to consumers. It also contains details of the costs of electrical energy to consumers in the various municipalities and tabular statements of the rates in force which have produced these costs. An explanation of the various tables and statements is given at the commencement of this Section on pages 229 to 233.

The Annual Reports of the Hydro-Electric Power Commission give more information respecting the operation of the co-operative hydro-electrical enterprise of the municipalities of Ontario than is obtainable with respect to other districts from the published reports of any other system of electric utilities, regardless of where operated or whether under public or private ownership.

May I, in concluding, say that no one is more conscious than I am of the great loss sustained by this Commission through the death of Sir Adam Beck. This great work, to which he gave so generously of himself, must be maintained and advanced.

While the people of the Province have every reason for deploring the passing away of one who did so much for them, it may be a satisfaction to know that my colleagues and I are fully determined to carry forward the work, having the same object in view that inspired Sir Adam Beck—namely, low-cost electrical service for the municipalities and citizens of the province of Ontario.

Respectfully submitted,
CHARLES A. MAGRATH,
Chairman.

Insulation Testers

By P. A. Borden, Assistant Labortory Engineer, H.E.P.C. of Ont.

(Read before Association of Municipal Electrical Utilities at Bigwin Inn, Muskoka, Ont., June 24, 1926)

THE merit of an insulating material or structure may to a great extent be determined by electrical tests performed upon it. Such tests may take several forms. In one method an electrical potential difference (usually alternating) is applied to the specimen and either increased until failure occurs, or maintained at a predetermined value for a specified time. In another method an actual measurement is made of the ohmic resistance of the material; and this may be done either at a voltage far below the breakdown value or, by means of a high voltage rectifier such as the kenotron, at a potential approaching that at which the insulation fails. It is evident that these tests will have different effects upon the insulation materials, and that their results will have to be interpreted in different ways. For instance a small air-gap of a few mils would show an infinite resistance if the test voltage were kept below the breakdown value, and yet would be quite unsuitable as an insulation on a high voltage circuit; whereas a winding showing a relatively low insulation resistance might be permissible for continuous operation on high tension service.

Scope of the Testing Set

In the performance of high voltage break-down tests it is usual to employ an alternating potential. Such voltages are more easily produced, regulated and measured than are direct. The results of high potential tests are, however, considerably affected by the wave form of the voltage used; and this, under test conditions, is not at all easy to determine. So, while there are many classes of circuits and of materials whose use demands that a high voltage test be performed before they can be placed in service, there are many others for which an insulation resistance test is quite sufficient; and even in those instances where the high voltage test is finally required, the resistance test is usually a valuable indication of the readiness of the circuit to sustain the severe stresses of the high potentials. In the present state of development, high voltage direct current testing is rather specialized and difficult of performance, and in the matter of convenience, where the latter is at all permissible, not to be compared with the simple portable ohmmeter type of insulation testing set.

Principles Available

For the measurement of resistance we have the choice of two principles, the bridge and the direct deflection method. The bridge method, best exemplified in the well known Wheatstone bridge and its numerous modi-

fications, makes for the highest accuracy of measurement, but lacks sensitivity when the available current is small, in that a portion only of the total current in the circuit under test flows through the detector circuit. Consequently, when very high resistances are to be determined, it is usual to employ methods where the total current flowing through the resistance may be used in the measuring instrument. The simplest of these, in theory, at least, consists in a direct comparison by means of a calibrated galvanometer between the current in the resistance under test and that in a known resistance under application of the same potential difference. This method, while capable of great sensitivity, and used considerably where very high insulation resistances are to be measured, and the voltage is limited, is essentially a laboratory method requiring great care of manipulation to obtain definite results. A modification of this method is found in the use of a high resistance voltmeter in series with the circuit tested, the (known) resistance of the instrument being taken as the standard[1]. A similar principle is applied in the Weston ohmmeter, which may be operated by a few dry cells, and gives direct indications of resistances as high as 100,000 ohms.

There are today available a number of insulation testers operating upon the principle of the direct reading ohmmeter. In this type of instrument the movement consists essentially of two separate windings displaced through an angle and carried upon a common shaft

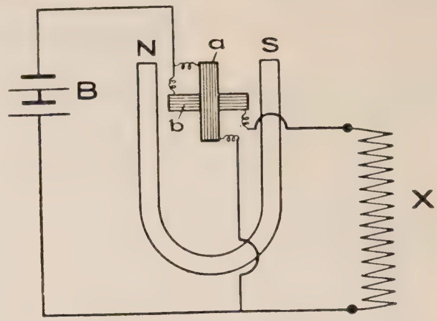

Fig. 1. Principle of the Ohmmeter. N-S—Magnets; B-Batttery: x—Unknown Resistance; a—Pressure Coil; b—Current Coil.

in the field of a permanent magnet, (See Fig. 1). The leading-in springs are in the form of filaments which exert no appreciable torque upon the movement, so that when unexcited the pointer may lie at any point on the scale. When the coils are energized, the position of the pointer will be representative of the relative values of the currents in the respective windings, without regard to the actual magnitude of these currents. If such a device be connected to an electrical circuit so that the current in one coil is proportional to the voltage applied, and that in the other to the actual current flowing, the indication of the instrument, depending upon the ratio of the currents, will furnish us with the value E/I, which, by Ohm's law, is the resistance of the circuit. Such an instrument may be made direct-indicating; and from its scale will be obtained a reading in ohms of the resistance of the circuit to which it is connected, without respect to the voltage which is applied.[2]

Source of Voltage

While in its principle the direct reading ohmmeter is independent of the value of the applied potential and may therefore be operated with a very moderate battery voltage when relatively low resistances are under measurement, it becomes necessary when testing high resistances to provide a considerable electromotive force in order that the reading may be definite. It has, therefore, become customary that those ohmmeters which are of a sufficiently high range to be classed as insulation testers be provided with a self-contained direct-current generator, (Fig. 5), usually of the magneto type, and manually operated through a convenient crank. For permanent installations the generator may readily be adapted for motor drive.

Types and Makes of Testing Sets

Of the insulation testers at present on the market, that which probably most closely approaches the theoretical ohmmeter in its design is the Harris "Omega," (Cambridge Instrument Co.) Fig. 2. In this instrument there are two similar windings carried upon a light cylindrical drum which surrounds a core in the magnet field. The planes of these coils are at right angles to each other, and each winding occupies half the available space within the gap. With this arrangement a very efficient use is made of the space, with the result that there is obtained a powerful directive effort, and a consequently positive reading, as well as a scale

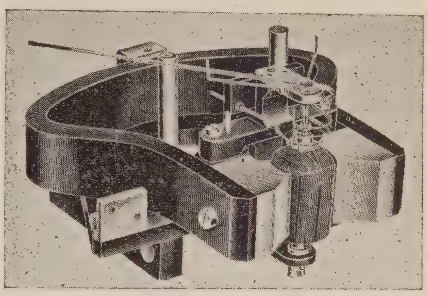

Fig. 2. Harris Ohmmeter, closely approaches theorectical ohmmeter.

of very satisfactory proportionality

Several makers have modified the ohmmeter scheme by separating the coils and displacing them axially on the shaft as shown in Fig. 3. This allows great flexibility in design, in that the coils, to meet a variety of requirements, may be of varying proportions and angular displacements, while the portions of the air-gap occupied by the respective windings may also be independently

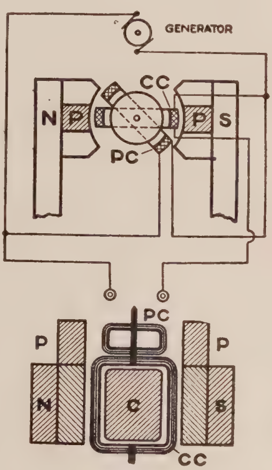

Fig. 3. The "Metrohm," N-S-Magnet; P, P—Pole-tips; C—Soft Iron Core; PC — Pressure Coil; CC — Current Coil.

modified. This arrangement is well exemplified in the "Metrohm," (Everett Edgecumbe)[3], and in the Record Ohmmeter (Record Electrical Co.) and in the "Vawter" (Thompson-Levering).

In an instrument known as the "Ohmer" (Nalder), use is made of the electro-static principle; and the device becomes in reality a portable electrometer. There are no magnets or coils, the movement consisting in a number of fixed and moveable vanes, so disposed and connected that their relative position becomes an indication of the ratio of voltage and current, and therefore of the resistance of the circuit under test. This type is particularly suitable for work at comparatively high voltages. Another, and a very simple, type of ohmmeter combines a generator and a delicate milliammeter. By means of a centrifugal device, operating when the generator has reached a speed corresponding to the predetermined voltage of operation, a clamping device is actuated, and the pointer locked in a position corresponding to the current through the tested circuit at that time.

Probably the best-known member of the family of insulation testers is the "Megger" (Evershed & Vignoles). This, while like the majority of other makes, of British manufacture, is widely used in both Canada and the United States. In fact it has reached the status of a standard piece of equipment to the extent that its trade name is becoming generic to all direct reading insulation testers, much to the annoyance of the makers both of the Megger and of the other instruments classed with it. The principle of operation will be understood by reference to Fig. 4. It is similar to the devices already described, with the double-coil ohmmeter element moving in the gap of a peculiarly shaped polar structure. With this arrangement there is obtained a powerful directive effort and a well distributed scale. Incorporated in the instrument is a hand-driven magneto, shown in Fig. 5, arranged to utilize, in common with the measuring element, the one set of permanent magnets. The Megger is obtainable in a great variety of ranges, some reaching as high as 20,000 megohms on the last finite point of the scale. Generator equipments are supplied in voltages from 125 to 2,000.

The "Bridge Megger" embodies the standard Megger instrument so modified that, by throwing a switch, the internal wiring is changed to the circuit of a Wheatstone Bridge, the generator serving as a supply of power, and the measuring element as a galvanometer. This, when used with an external resistance box, enables accurate measurements to be made of resistances from one megohm down to less than one ohm. A late development of the Megger into a small portable form is shown as the "Meg"; and, with this instrument, weighing but a few pounds, it is possible to make all insulation tests required in ordinary wiring installations.[4] A very recent production by the same maker is an earth-plate tester, [5]which, while in its measuring principle, almost identical with the Megger, uses an alternating current generator, whose

output flows in the tested circuit, being afterwards rectified for measurement in the ohmmeter element. By this means there are eliminated the effects of polarization and stray electromotive forces, so troublesome in ground resistance measurement.

Applications of Insulation Testers

The most common application of the insulation tester lies probably in the installation of new circuits or equipment, where it is almost imperative that an insulation test be performed before the wiring or apparatus be connected to the lines. All wiring codes specify very definitely that the installation must withstand certain tests of this nature as an index to the condition of the insulation. In the drying out of transformers and machines, the information obtained from these tests is of inestimable value. And in modern maintenance practice it is customary to maintain a continual surveillance over the condition of insulation of plant and wiring, so that impending faults may be detected and eliminated before actual failure takes place. What may be looked upon as the outstanding application of the insulation tester in this country is doubtless found in its use on line insulators. It is interesting to note that the "Megger" test for high tension insulators was originally developed by engineers of the Hydro-Electric Power Commission of Ontario about thirteen years ago, and that it has since become standard practice upon most high tension transmission systems By its use cracks and flaws are detected while the insulators are still in service, enabling their removal and replacement long before the total insulation of the line has reached a condition approaching failure.[6], [7], [8].

Precautions in Use

There are several elements entering into insulation testing which may be held responsible for most inconsistencies, discrepancies and apparent errors encountered in this work. These may be generally classified as (a) Voltage, (b) Leakage, and (c) Temperature and Humidity effects, to which must be added (d) those errors introduced by possible transient phenomena in the circuit under test.

(*a*) *Voltage Effects.*

The value of the resistance of some forms of semi-conductors varies materially with the applied voltage. This phenomenon is traceable variously to the physical characteristics of the material, to ionization effects and to entrapped moisture, the last probably predominating in the case of potentials below 2,000 volts. As a result it is sometimes observed that a cable or insulator tested with a 500 volt instrument will give an entirely different value when tested at 1000 or 2000 volts. As might be expected, the higher voltage usually gives the lower resistance reading. It is necessary, therefore, when specifying tests of this class, to include in the specification the limits of voltage to which the specimen is to be submitted.[9]

(*b*) *Leakage Effects.*

When testing very high resistances, trouble is sometimes experienced from creepage over surfaces detween points of differing potential, the current so shunted passing through the circuits of the instrument and falsifying the readings. The stray current may pass over the surface of the test set, if allowed to become wet or grimy, or it may leak across between points of application of the testing circuit to the insulator. This may be eliminated by the use of a guard circuit, ("G" Fig. 4), whereby such currents are conducted around the measuring element and have no effect upon its indications. In insulation testers for high range work, the guard circuit is usually provided with an extra terminal, so that the feature of protection against creepage may be extended to the specimen under test. It is desirable to avoid, wherever possible, the use of twin cord for leads between the testing instrument and the circuit tested. Such a cord is likely to deteriorate rapidly in service, becoming the equivalent of a low insulation resistance placed in multiple with that tested, and falsifying the results obtained.[10], [11], [12].

In the testing of lines, every precaution should be taken to avoid

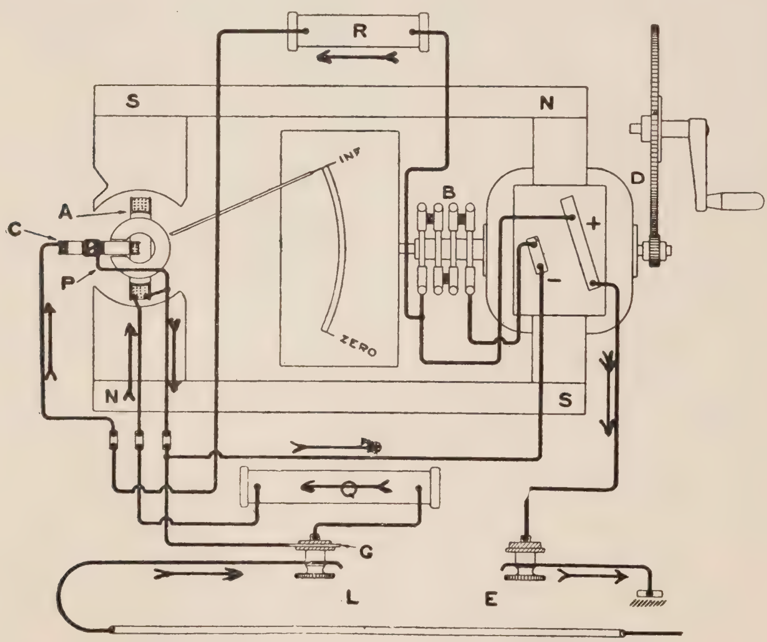

Fig. 4. Diagram of connections of Evershed's "Megger." Testing Sets. A—Current Coil; P—Pressure Coil; C—Compensating Coil; N, S—Magnets; Q, R—Resistances; B—Brush Gear; D—Driving Gear; G—Guard Plate; L, E—External (Line and earth) Terminals.

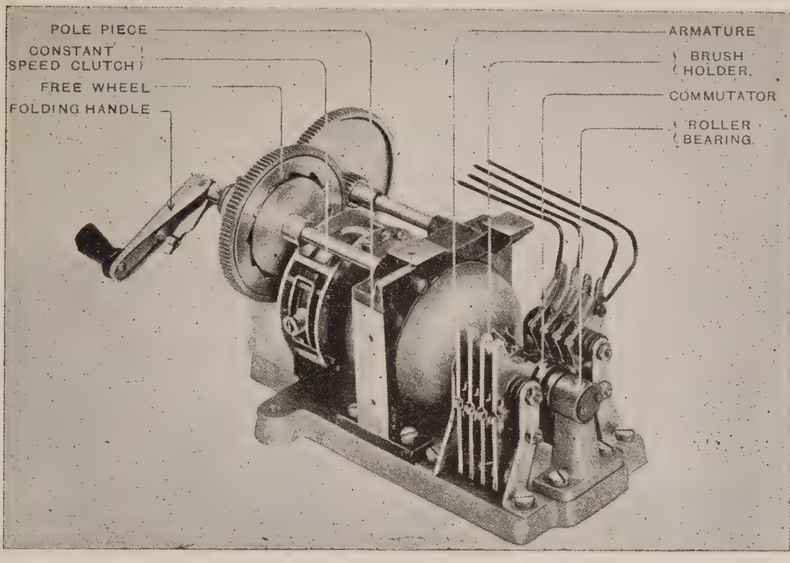

Fig. 5—View of constant pressure generator, Bridge-Megger type.

connecting the instrument to a circuit in which potentials may already exist, either from interconnection with a supply system or by electrostatic or electromagnetic induction from neighboring circuits. The danger of attempting to test the insulation of a "live" line is too evident to require any elaboration; but, on the other hand, one might be tempted to overlook the existence of potentials arising from induction or leakage from external sources, which, besides introducing serious errors in the readings, are very likely to endanger not only the circuits of the testing set, but the life of the operator.[13]

(*c*) *Temperature and Humidity Effects.*

The insulating value of most dielectric substances is materially affected by temperature. For a relatively small increase in temperature the insulation resistance decreases greatly, and vice versa. On any apparatus found fit to be put in service, insulation tests should be made at the normal operating temperature; that is, the measurements should be made immediately after shutdown. It is generally desired to make repeated readings of insulation resistance at various temperatures, so that variations from time to time may be better observed.

The guard circuit described in an earlier paragraph as a means of eliminating the effects of surface creepage, does not take account of moisture absorbed into or entrapped within the material of the insulation; and it is not logical that it should do so. In fact, one of the most important uses of the insulation tester is to determine just what part moisture is playing in the condition of the apparatus. It is not

permissible, therefore, to assume that an insulating medium is dry until insulation resistance measurements have shown it to be so. In drying out machines or transformers it may be generally said that, with due regard to the temperature at which observations are made, complete dryness is shown by the readings becoming constant in value. New or repaired apparatus, in which the insulating varnish is not dry, is spoken of as "green". In such cases the insulation resistance is apt to be quite low; and the apparatus is not safe to be put into operation

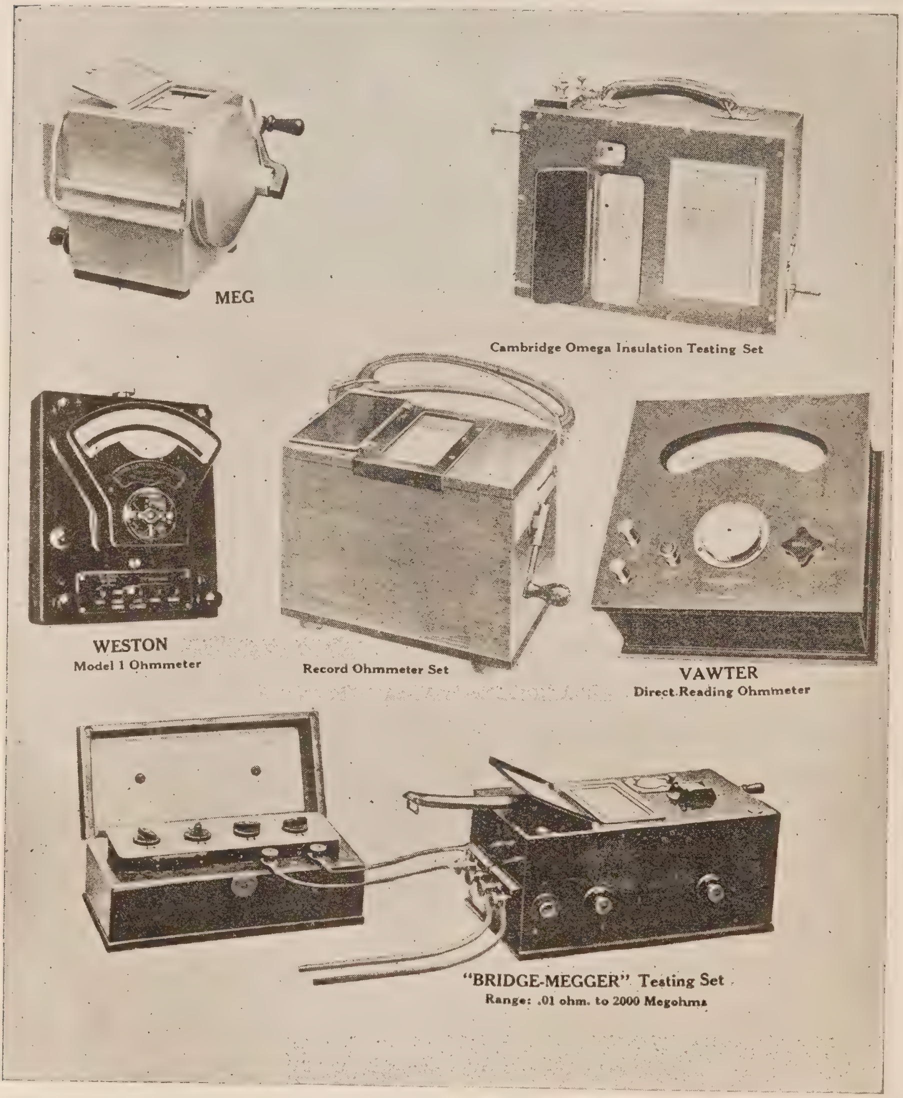

Fig. 6—Group of Insulation Testing Sets.

until it has been thoroughly baked or dried, with tests made during the process, just as when drying out ordinary moisture.[14]

(*d*) *Effect of Transients.*

In circuits which embody appreciable inductance or electrostatic capacity, it is necessary that the voltage be steady during the test. When testing a transformer or a considerable length of cable, it will often be observed that the pointer of the instrument takes a noticeable time to come to rest; and to obtain a correct measurement it is imperative that a condition of equilibrium be allowed to obtain. Transformers should, wherever possible, be connected non-inductively to the circuits of the test set; that is to say, the two ends of a coil should be tied together and attached to the instrument. This will minimize, though probably not entirely annul, the inductive effect. Most testing sets with self-contained generators are arranged with a "constant-pressure" feature, so that the speed of the armature will not exceed a specified value if the crank be driven above its normal operating velocity.

Care of Instruments

Insulation testers are entitled to the same degree of care in handling and use as are other types of electrical measuring instruments. While usually as rugged as practicable in construction, the apparatus always contains a delicate jewelled movement, which can be expected to give satisfactory service only with careful handling. When shipped, such an instrument should be enclosed in a properly padded case, and when otherwise transported it should not be dropped or allowed to bounce about on the floor of a motor truck. It should also be kept reasonably clean and guarded from dampness. A film of soot, grime or moisture, bridging the terminals of the instrument, may easily introduce serious errors in its readings. Dust and chemical fumes will penetrate the most perfectly constructed case and do untold injury to the delicate parts within. On an instrument provided with external switches for changing its ranges, or with a zero adjustment, these parts should not be subjected to severe mechanical strains. If they do not function in a proper manner it may be assumed that the instrument is defective and in need of repairs. And, in conclusion, it may be mentioned that the laboratories of the Hydro-Electric Power Commission are well equipped to perform all ordinary repairs and adjustments upon insulation testing sets and similar devices, and that for the Megger there is carried a stock of replacements and spare parts.

* * *

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The Second Article on

Application of Hydro-Electric Power to Farm Work:

Will Appear in the August Number.

Voltage Variation as Affecting the Quality of Electrical Service

By J. W. Peart, Engineer, Public Utilities Commission, London, Ont.

(Read before Association of Municipal Electrical Utilities at Bigwin Inn, Muskoka, June 24th., 1926)

POSSIBLY no one problem is of as vital interest to the majority of power distributors to-day as that of voltage regulation. The subject is a large one and is general over transmission and distributing systems, beginning at the generating stations and terminating in the consumer's premises. All studies along this line have but one objective, and that is to deliver energy to the consumer at the lowest possible cost per unit consistent with the maintenance of good service.

Now, in speaking of good service in-so-far as an electrical utility is concerned, two factors are of outstanding importance:—

1. A maximum of uninterrupted supply.
2. A supply of energy of such "quality" as to match up with the required standard, which, according to the requirements of our Government, stipulates that the voltage on lighting services must not vary beyond + or − 4 per cent.

The latter point furnishes much food for thought. The word "quality" is found but rarely in the vocabulary of an operating engineer yet it is certainly applicable to his commodity, electrical service, as well as to dry goods, groceries, or gasoline. The quality of electrical service afforded throughout the country to-day may be classed as either good, bad, or indifferent. One distributor may engage competent engineering advice to study matters carefully, and install remedial equipment so as to provide the consumer with the utmost in service. Another may be satisfied to add consumers to the system network continually, thereby creating overloads and low voltage conditions with the result that in the end he is deluged with complaints and harassed by failures of equipment.

The quality of an electrical service is directly dependent upon voltage regulation. It has been said that electrical energy loses its value as a commodity when variations in voltage exceed certain limits. The foregoing, although a broad statement, is quite true in the final analysis.

Every current-consuming appliance on the market to-day, whether it be an incandescent lamp, induction motor, stove, or water heater, is designed to give its maximum efficiency at a specified voltage. Slight variations, not exceeding + or − 5 per cent., need not occasion any concern, but variations beyond these limits will tend to interfere with the efficient operation of the current-con-

suming appliance. Consequently, it is the duty of the power distributor to see that the voltage on consumers' services is maintained within these limits. This can be done by paying proper attention to the following factors:—

1. The design of the 4,000 or 2,300 volt primary feeders as regards routing and wire size.
2. The most strategic, yet practical, location for service transformers, in order that the length of secondary feeders may be a minimum.
3. The design of the 220/110 volt secondary feeders, as regards wire size and balancing, so as to reduce the current in the neutral to a minimum.
4. The use of automatic voltage regulators on primary lighting feeders.
5. The segregation of motor load on separate 4,000 or 2,300 volt feeders wherever economically possible.

The average engineer making a study of distribution problems is faced with many difficulties. There may be one district on the system which is newly built up and where new services are being made constantly. In this case, he is called on to anticipate a certain load within a number of years and to build the required extension accordingly, yet within what would appear as reasonably economical limits. In another district, there may be old lines which are subjected to heavy increasing loads, such as in business districts. Again, there may be old lines in residential districts where a gradually increasing load is noticeable on account of the addition of stoves and other appliances. Such conditions are to be found on the average system to-day, and they must be dealt with in a competent manner if the consumer is to be given the service he is entitled to and a reasonably high efficiency of distribution is to be maintained.

It is safe to say that the distributor's system is judged mainly by the quality of lighting service rendered. This is due to the facts that a number of systems will average from 20 to 25 lighting consumers to one power consumer, and that wide variations in voltage on lighting circuits are perceptible to the eye, while similar variations on power circuits, although also detrimental, are not as readily observed.

Variations in voltage on lighting circuits produce the following results:—

1. A change in the candle power of the lamps and a resultant variation in the illumination.
2. A change in the specific watt consumption.
3. A variation in the durability of lamps.

These three points might well be given further consideration as their importance cannot be overestimated.

The outstanding observation in connection with voltage variations on incandescent lamps is that a drop in voltage results in less illumination. The effect is accentuated by the fact that for a 10 per cent. drop in voltage there is a corresponding 30 per cent. drop in the amount of illumination. If the change occurs rapidly, consumers will immediately notice the reduced illumination; but if it takes place

gradually, there is a possibility that it will be unobserved. Another important result which must be borne in mind is that the same 10 per cent. drop in voltage occasions a corresponding 15 per cent. reduction in consumption.

The second point, that relative to the specific watt consumption, may be brought out as follows:—

When tungsten lamps are burned at rated voltage, they yield from 9.0 to 9.9 lumens per watt, depending on the size of the lamp. In the case of the 60 watt lamp, a resultant illumination of 575 lumens is obtained. If the voltage falls 10 per cent., the same lamp yields only 403 lumens; and one watt now produces 7.9 lumens instead of 9.59, the normal value for this size of lamp. On the other hand, a 40 watt lamp burning at normal voltage will afford just as much light as the 60 watt burning at 90 per cent. voltage. Thus, it is quite evident that low voltage tends to decrease the efficiency of incandescent lamps materially.

The last mentioned result of voltage variations, a change in the durability of lamps, is also worthy of consideration. Lamps manufactured to-day are designed for a definite number of burning hours at a stated voltage. Low voltage, of course, will tend to lengthen the life; but increased voltage will greatly reduce it. It has been shown in the case of a lamp subjected to 10 per cent. high voltage, there is a life-reduction of 50 per cent., with an accompanying increase in power consumption and illumination. Hence, purchasers would benefit greatly if supplied with lamps rated at the maximum voltage which might obtain during their period of use, provided such a maximum did not exceed the average voltage by more than 5 per cent.

Such are the effects of voltage variations upon lighting loads. It will now be of interest to see how these same variations affect the efficiency of heaters, stoves, water-heaters, etc., all of which form a very integral part of the load occurring on lighting feeders to-day. In the first place, these appliances perform their various functions with approximately a constant resistance value, as compared with the hot and cold resistance of incandescent lamps. Their power consumption does not vary directly as the voltage, but as the square of the voltage. Thus, a 1500 watt stove element rated at 115 volts, when subjected to a 10 per cent. drop in voltage, will consume, not 90 per cent. as much power, but 81 per cent. Therefore, the element normally using 1500 watts now only takes 1220. The outstanding result of this appears in the longer time taken to perform a certain cooking duty, to say nothing of the increased radiation losses. Curves which have been produced to give the relation between voltage variations and the time taken in cooking, show that a drop in voltage of 10 per cent. increases the cooking time by 25 per cent. Assuming the cooking time with normal voltage as 30 minutes, the watt-hours consumed would be 750. With only 90 per cent. voltage, the time is increased to 37½ minutes, and a consumption of 763 watt-hours is recorded, so that the efficiency of the element is reduced from 100 per cent. to 98.3 per cent. Thus

it appears that the most important observation as to the effects of low voltage on stoves is, not the slight decrease in efficiency, but rather the increased time in cooking. Now, although the old outstanding objection to the use of the electric stove, namely, the time taken in cooking even at normal voltage, has been overcome by the introduction of high wattage elements, it remains of utmost importance that stove users should be supplied with reasonably normal voltage in order that the highest degree of satisfaction may result.

Increased voltage will produce favorable results for the time being in connection with the use of cooking elements; but, as in the case of lamps, the durability suffers and the power consumption increases.

The induction motor, which is the type of motor in most general use to-day, exhibits the following results when subjected to a drop in voltage while operating at normal load:—

1. The efficiency drops.
2. The power factor rises for the first 10 per cent. drop, then falls.
3. The torque drops rapidly.

A 10 per cent. drop in voltage will lower the efficiency probably 1 per cent., and consequently need not be considered seriously. The same 10 per cent. drop will raise the power factor, but if the drop becomes greater, it will start to fall again. The torque, however, which is the factor by which the average consumer judges a motor, is reduced in proportion to the square of the voltage; consequently, a 10 per cent. reduction immediately lowers it by 33 per cent. Induction motors are, as a rule, designed for a maximum torque of from 180 per cent. to 200 per cent. of the normal torque in order to start under heavy loads. If a motor designed with a maximum torque of 185 per cent. has a starting duty requiring 160 per cent., a 10 per cent. voltage drop will afford only 150 per cent. torque, and the result is that the motor cannot start its load. Consequently, motor purchasers are inclined to install oversize units rather than be inconvenienced by using smaller motors which would operate perfectly at normal voltage, but would prove useless under low voltage conditions. This practice works out very well, but when normal voltage obtains, poor efficiency and low power factor result. Large voltage drops will very often cause injurious heating in a motor due to the increased copper loss.

From the foregoing, it is seen that in induction motors, torque is probably the factor most affected by low voltage and most productive of trouble to the consumer. In future purchases, in order to guard against the low voltage evil, he is likely to buy motors actually larger than required. In the meantime, if the distributor has corrected the trouble and restored normal voltage, the consumer's new over-size motor becomes a source of poor power factor on the system. Were such instances to become general, the operating engineer would have his hands full boosting his system power factor and collecting power factor penalties.

In general, when voltage decreases, stoves are slowed up considerably and meals delayed, motors refuse to do their normal day's work, and irate manufacturers worry operating engineers. From the point of view of public opinion, however, it is the effect on illumination that is most serious.

But all have a material effect on the attitude of the public to electrical service. Distributors, as a rule, are cognizant of the fact that, in order to gain good-will generally, it is necessary to furnish the consumer with service of the highest quality justifiable from an economical point of view, and to raise their efficiency of distribution to a maximum.

Ontario Municipal Electrical Association and Association of Municipal Electrical Utilities

Report of Committee on Retirement and Death Benefit Plan of the O.M.E.A. and A.M.E.U.

"To the Officers and Members of the O.M.E.A. and A.M.E.U.:

Your Pension and Retirement Plan Committee appointed June 24th, 1925, beg leave to present their second report, as follows: A progress report was presented at the Annual Meeting at Toronto on January 19th of this year, and your Committee re-appointed with instructions to work with the H.E.P.C. with a view to obtaining any legislation necessary to set up the machinery to make available to the various Municipal Electrical Systems a plan of annuities, total disability pension and death benefits.

Copies of this report were printed and distributed to all Municipal Electrical Utilities and various plans have been received and considered.

Legislation was prepared by the Solicitors of the H.E.P.C. and submitted to the Government for approval, but unfortunately was not dealt with at the last Session of the Legislature.

In order that there might be no misunderstanding as to the status of the Municipal Commissions, your Committee asked the Chairman of the H.E.P.C. to secure a written legal opinion from the Solicitors to the Commission, which is as follows:

"Memorandum to Mr. C. A. Magrath: Subject, Pension and Insurance Plan for Municipalities: June 18, 1926: With reference to the attached letter of the 15th inst. from the Secretary of the Ontario Municipal Electric Association to yourself, asking for a legal opinion as to "Whether Municipalities legally have authority to enter into contracts with an Insurance Company and whether they have authority to pay over money because of such contracts or, if they have not this

authority, what legislation will be necessary to give them this authority," I would advise as follows: Under Section 406 of the Municipal Act, paragraph 12, the Councils of Cities and Towns may pass by-laws "for granting aid for the establishment and maintenance of superannuation and benefit funds for the members of the police force and of the fire brigade and of their officers and employees of the Corporation and of their wives and families."

This provision, however, does not extend to local Hydro or Public Utility Commissions established under the Public Utilities Act as there is at present no legislative authority for local Commissions to enter into such contracts.

Legislation of this nature was drafted and submitted to the Government during the past Session of the Legislature, but it was not introduced.

This draft legislation provided that contracts might be entered into with Insurance Corporations for providing insurance for the employees of local Commissions by way of service annuities, income annuities, or death or total disability benefits, or upon such other plan as might be expedient.

In my opinion, some such legislation is necessary to authorize local Commissions to provide pension and insurance benefits for its employees. (Signed) I. B. Lucas."

Your Committee would therefore recommend that a strong deputation wait on the Provincial Government to request that legislation be enacted at the earliest possible moment to permit the Municipal Electrical Systems to enter into contracts for the inauguration and carrying on of a pension retirement and insurance plan for the benefit of their employees."

Association of Municipal Electrical Utilities

The Secretary's Report

The year 1926 shows the membership of the Association to have again increased as it has each year since its inception. In 1925 there were 148 utility members and 10 rural power districts included as such. Deeming the benefits of the Association to the rural power districts to come through other membership in the Association, their names have been withdrawn from the Association lists. Of the utilities that were members during 1925 the following have neglected to renew their membership for this year:—Amherstburg, Bracebridge, Brampton, Cochrane, Fergus, Glencoe and St. Jacobs. New utility members for 1926 are Beachville, Carleton Place, East York Township, Georgetown, Hagersville, Harrow, Humberstone, Lanark, Palmerston, Penetanguishene, Port Stanley, Rodney and St. Clair Beach, bringing the total to 154.

There were 34 commercial members in 1925, one of which failed to renew its membership for 1926. Applications were received from 4 additional Companies, making the total for 1926, 37. The new Companies eligible for commercial membership are:—

Continental Electric Co., Limited, Toronto.

Dominion Insulator Mfg. Co., Toronto.

Gutta Percha & Rubber, Ltd., Toronto.

Kelvinator of Canada, Ltd., London.

The Association lists include a total of 721 names, classified as follows:—

Class A	220
Class B	276
Associates	67
Commercial	158

In 1925 the total was 619.

(Sgd.) S. R. A. Clement,
Secretary.

Report of Regulations and Standards Committee

This Committee recommends to the Convention that the Rules and Regulations in use on the Central Ontario System be adopted for use throughout the Province and embodied in the Hydro-Electric Commission's Rules and Regulations. They come under the Inspection Department of your Commission rules, and are as follows:—

"*Service Space:* The customer's wiring shall be brought outside the building to a point on, or within three feet of the building wall nearest the supply authority's line; where it will not interfere with windows, awnings or other parts or attachments to the building, and so located that it will be readily accessible to service wires brought from the supply authority's pole. In no case shall the height of the wires be less than twenty feet from the ground. The free ends of the wires for service connection shall not be less than thirty inches in length.

Meters, space and location:

Meters shall be located in a clean, dry, safe place, free from vibration. Meters shall not be located in toilet rooms, bathrooms, attics, bedrooms, coal or wood bins, or on walls of coal or wood bins, or any place not readily accessible or desirable.

Meters may be located (a) on porches or verandahs, provided they are protected from the weather. (b) In cellars, kitchens, ground floor halls. (c) In built-in compartments in walls accessible from the outside of the building.

Space shall be provided for meters as follows: (a) For lighting meters 50 amperes and under, 12 inches square. (b) For power meters for loads 10 H.P. and under 12 inches wide by 20 inches high.

Each wire for meter connections shall have an exposed length of not less than 18 inches. Any wiring from the main entrance box to the meter shall be in rigid iron conduit.

The use of approved entrance boxes with special top walls designed to fit bottom connected meters is acceptable and desirable. A list of approved makes of boxes of this type will be supplied by the supply authority, on request.

The centre of the space provided for the meter shall be located so that it is not less than four feet from the floor or not more than six feet from the floor.

Any case which is not covered by the above rules shall be considered as special and a ruling shall be obtained from the supply authority before construction is begun."

The Committee also recommend that, to provide for adequate consideration for the discussion of metering problems, a separate "Meter Committee" be organized. It is the feeling of the Committee that the metering problems require more consideration than can be given by this Committee."

Report of Committee on Accident Prevention and Health Prevention

After the organization of the Committee a meeting was held in Toronto on April 13th, 1926. The principal points taken up had reference to the present Convention and arrangements were made to have Mr. V. A. Sinclair, Chairman of the Workmen's Compensation Board, present a paper and also to have the presentation of a film entitled, "Someone At Home." Had the Convention been held in Niagara Falls, certain other interesting arrangements were in hand, but these can be looked after at a later Convention.

Last year, due to the assistance of the various Municipal Utilities, demonstrations and instructions in resuscitation were given to troops of Boy Scouts and a great deal of practical benefit resulted. In Galt, this instruction was directly responsible for the saving of a boy's life, that but for the instruction of the Scouts, would have been lost. The Committee again appeals to the Municipal organizations for co-operation in this work and to have demonstrations given to the troops of Boy Scouts.

Certain other work in connection with Accident Prevention has been taken up by the Committee and a complete report will be presented at the Winter Convention.

(Sgd.) Chas. T. Barnes,
Chairman.

Report of Merchandising Committee

A meeting of the Merchandising Committee was held on April 16th, 1926, with practically every member of the Committee present. The meeting was called to discuss the possibility of having manufacturers revise their discounts to give Hydro Shops and others a wider margin of profit in merchandising electrical goods.

After some discussion on the subject it was moved by Mr. E. V. Buchanan and seconded by Mr. Childs that the manufacturers of larger appliances be consulted to ascertain whether an arrangement could not be made so that at least a 5% increase in margin would be available and that in selling these appliances competitors would be

called upon to use the manufacturers' list prices. Under these arrangements the Hydro Shops would be enabled to extend a discount for cash and allow list prices to remain the net prices where goods are sold on a time basis to meet departmental store competition where necessary.

It was also agreed that all Hydro Stores stick strictly to retail prices on larger appliances and that in cases where local advertising effects surrounding Municipalities any lowering of prices by one Municipality should be approved of by others effected.

It was moved by Mr. Buchanan and seconded by Mr. Childs that a standard form of lien note be drawn up by the Hydro Legal Department combining the desirable features of lien notes now in use in different towns so as to standardize the method of handling sales on which lien notes are taken.

At this meeting operating reports of about twenty-five Hydro Shops for 1925 were submitted and discussed and it was clearly apparent that some action was necessary one way or the other in order to make it easier to show a profit than is now the case.

As pointed out at the meeting if all of the legitimate operating expenses which might be charged to a Hydro Shop were taken into account some of the profits which now appear would be considerably reduced and aside from the question of economies which might be effected in operation the margin of profit as shown by these reports is entirely too small.

After discussing at length the different items of expense which make part of Hydro Shop Operation it was agreed that the following recommendations be made:—

(1) Where a Hydro Shop is administered by the local Superintendent, or Manager, or Secretary as part of his local duties, at least 5% of the value of sales should be charged to the Hydro Shop for management.

(2) Where servicing is being done on appliances sold through the Hydro Shop during the guarantee period, or otherwise, the cost of this servicing should be charged to Hydro Shop Operation and be shown separately in the accounts.

(3) A reasonable charge for rent to cover carrying charges on occupied buildings if the latter are owned by the Utility, or a fair proportion of rent paid for occupied buildings if the buildings are not owned by the Utility, should be charged against Hydro Shop Operation.

(4) An adequate reserve should be set up to cover uncollectible accounts and no less than ½ of 1% of outstanding accounts is considered necessary.

(5) Interest at the rate of at least 6% per annum on the net amount invested in the Hydro Shop should be charged as a monthly charge.

(6) A depreciation of 25% on the original value of trucking equipment should be written off automobiles or delivery trucks used in connection with Hydro Shop Operation.

(7) A depreciation of 10% should be written off the original cost of office equipment used in connection with Hydro Shop Operation.

(8) A reserve should be set up for stock depreciation sufficient to cover shrinkage in stock from various causes from time to time. At the present time a number of towns are carrying heavy inventories made up in part of obsolete and out of date material with no surplus sufficient to absorb depreciation which should be written against this old stock.

At this meeting also certain suggested rules to govern the sale of electrical appliances on a time basis were read and approved as follows:—

(1) When the sale amounts to $3.00 or less the terms shall be cash, with the exception of purchases for service which cannot be readily collected by a service man. Purchases thus made are to be included with the next regular instalment payment due and added to the monthly lighting bill.

(2) Credit may be extended and instalment accounts opened up with customers whose credit is considered good, or those who have previously lived up to the terms of instalment contracts, or those who have been in the habit of paying their lighting bills within the discount period.

If a customer is carrying an instalment account and is not making the payments according to the terms of the contract entered into, no further sales are to be made on the instalment basis until the existing account is paid up or arrangements are made for the prompt payment of the instalments due on the old account.

(3) In making a sale on the instalment plan, a down payment of not less than 10% should be secured, and the balance spread over a period of not more than twelve months.

(4) If the sale made on the instalment plan includes wiring for the installation of an appliance the minimum of 25% should be secured as a down payment and the balance spread over a period of not more than twelve months.

(5) Where wiring has been done to install an electrical appliance for a tenant, no matter how large or small the cost of the wiring may be, the full amount of the instalment cost is to be collected before the work is started. This obtains when the owner of the property refuses to pay for the instalment cost, or extra wiring necessary to install appliances.

(6) To the balance unpaid after the first payment has been made on a purchase, a surcharge of 6% is to be added to cover interest and carrying charges, and the new total divided into equal monthly instalments.

(7) If a customer desires to take up unpaid instalments before they are due, an allowance at the rate of 6% per annum on

such instalments should be allowed to compensate for interest and carrying charges added to the instalments when the original purchase was made.

(8) A lien note should be signed by the purchaser of an appliance on the instalment plan in triplicate, one copy should be registered to secure the account, one copy given to the customer, and one retained for office use. Registration is necessary to make possible the repossession of the article sold in the case of non-payment except in cases where the name of the Hydro Shop is affixed to the appliance either by name-plate, stencil transfer or otherwise, to indicate by whom the appliance was sold to the consumer.

(9) Monthly instalments as they become due are to be added to the monthly lighting accounts. Where bi-monthly billing is in force, a separate bill, preferably on the regular lighting bill form, is to be sent to the customer in the non-billing months, as a reminder that payment is due and expected.

(10) The collection of the monthly instalments due to be impartially enforced. Only in extreme cases should a customer be allowed to miss a payment.

(11) When instalment payments are in arrears for thirty days, without permission, the appliance covered by the lien note is to be repossessed by the Hydro Shop, or service for lighting discontinued until satisfactory arrangements are made for the continuing of the instalment payments as agreed upon.

(12) When a customer moves away leaving behind unpaid instalments on appliances purchased, if it is impossible to seize the appliances before they are removed from the premises an attempt should be made to seize them at his new residence. If the latter is a Hydro Municipality, its co-operation should be sought in effecting collection, and service should not be given to a customer who leaves one Hydro Municipality and moves to another leaving unpaid bills behind, until satisfactory arrangements have been made to pay these over-due accounts.

(13) A standard lien note form is printed on a card, on the reverse side of which provision is made for recording the time payments as they come in, and customers should be required to bring their cards so that receipt can be given each month when each instalment is paid.

(14) When customers fail to pay their monthly instalments as they become due, a system of follow-up forms should be adopted to remind customers of their delinquency before the next payment becomes due. A notice should be sent out four days after the instalment should have been paid. If payment is not made within ten days thereafter, another notice should be sent out, and this latter notice should give the customer forty-eight hours in which to pay before repossession

action is taken, and the situation should be clearly outlined to the customer in debt with the final hope that settlement will be made before repossession is resorted to.

(15) Repossessed appliances should be held for twenty days, in accordance with the law, and then sold for whatever they will bring, the proceeds being applied on the account. If these proceeds are not sufficient to cover the balance outstanding then the debtor is to be sued for such balance.

On account of the value of the discussions which took place at this meeting it was suggested that the Managers of Hydro Shops and those interested in merchandising get together more frequently for a round table talk on subjects of mutual interest and it is hoped to have another meeting such as this in the very near future.

(Sgd.) V. S. McIntyre,
Chairman.

Minutes of Convention

The Nineteenth Semi-Annual Convention of the Association of Municipal Electrical Utilities was held at the Bigwin Inn, Lake-of-Bays, Muskoka, Ont., on June 24 and 25, 1926.

At 12.00 o'clock noon on June 24th, prior to the opening session, the delegates met for the first convention luncheon which was addressed by Professor Heaton of Queen's University, Kingston, his subject being "Cranks". This luncheon was held jointly with the Ontario Municipal Electrical Association, with Mr. R. H. Starr, President of this Association, as Chairman.

The first session of the convention was called to order at 2.00 p.m. by the President, Mr. R. H. Starr. Owing to the limited time for this session, the President's address and reading of reports was dispensed with, the same to be printed in the Bulletin of the Hydro-Electric Power Commission of Ontario. The reports disposed of in this manner were: The Secretary's Report, The Report of the Committee on Accident Prevention and Health Promotion and The Report of the Merchandising Committee.

Mr. W. H. Childs announced demonstrations of a billing machine to be made that afternoon and during the following forenoon.

Mr. P. A. Borden, Assistant Laboratory Engineer, Hydro-Electric Power Commission of Ontario, read a paper entitled "Insulation Testers".

Mr. J. W. Peart, Engineer, Public Utilities Commission, London, read a paper on "Voltage Variation as Affecting the Quality of Electrical Service." Discussion following this paper was by Messrs. C. E. Schwenger, E. V. Buchanan, P. A. Borden, G. F. Drewry, J. H. Caster, A. Schofield and R. T. Jeffery.

Mr. J. E. B. Phelps, Chairman, Regulations and Standards Committee, made an announcement of a meeting of that committee to be held that afternoon.

The session adjourned at 4.00 p.m. Immediately after this session the convention was favored by a

band concert by the Anglo-Canadian Concert Band of Huntsville.

At 6.00 p.m. the delegates and the members of the Ontario Municipal Electrical Association met for the convention dinner. Mr. C. A. Maguire, Commissioner, Hydro-Electric Power Commission of Ontario and President, Ontario Municipal Electric Association, presided and introduced Mr. P. W. Ellis, Chairman, Niagara Falls Park Commission, Chairman, Toronto Hydro-Electric Commission and Chairman, Toronto Transportation Commission, who spoke on the work of the Niagara Falls Park Commission. Mr. C. A. Magrath, Chairman, Hydro-Electric Power Commission of Ontario, also gave a short address.

The second session of the convention being a joint session of the Ontario Municipal Electric Association and Association of Municipal Electrical Utilities under the Chairmanship of Mr. C. A. Maguire, President, Ontario Municipal Electric Association, opened at 10.00 a.m. on Friday, June 25th.

Mr. Wills Maclachlan drew attention to copies of a pamphlet "Linemen's Safety Meeting" by the National Safety Council, Chicago, Ill., that had been placed in the room for general distribution.

Mr. T. J. Hannigan, Secretary of the Committee on Pensions and Retirements, presented a report of that committee and moved its adoption. On being seconded by Mr. V. S. McIntyre, the report was discussed at some length and Mr. Hannigan's motion carried.

Mr. J. E. B. Phelps, Chairman of the Regulations and Standards Committee, asked the chairman for a ruling as to whether a recommendation taken up at a joint session of the two associations would go forward to the Hydro-Electric Power Commission of Ontario, or would it be necessary to send it to the O.M.E.A. and through them to the H.E.P.C. of Ont. The chairman stated that such recommendation would go direct to the Commission.

Mr. Phelps then presented a report of the Regulations and Standards Committee making suggestions regarding the Rules and Regulations of the Hydro-Electric Power Commission of Ontario, and moved its adoption. On being seconded by Mr. R. H. Starr, the details of the report were discussed in turn and Mr. Phelps' motion carried.

Mr. Phelps then made a recommendation that the A.M.E.U. organize a Meter Committee, and asked Mr. P. A. Borden to present his suggestions *re* methods of insuring accuracy of watt-hour meters used as Standards by Municipal Systems. After Mr. Borden had outlined the work being done by the Canadian Electrical Association toward this end and answered questions by a number of the delegates, it was moved by Mr. J. E. B. Phelps and seconded by Mr. R. H. Starr that the matter of methods of insuring accuracy of watt-hour meters used as Standards by Municipal Systems be referred to the Executive Committee of the A.M.E.U. Carried.

Mr. Wills Maclachlan then showed a moving picture—"Someone at Home".

At noon the delegates met for the second convention luncheon, and

were addressed by Mr. V. A. Sinclair, Chairman, Workmen's Compensation Board, on "Accident Prevention and the Workmen's Compensation Board."

The third session of the convention opened at 2.00 p.m. with Mr. R. H. Starr as chairman.

Mr. Gordon W. Kingsbury, advertising manager, Kelvinator of Canada, Limited, read a paper on "Electric Refrigeration, General Development, Central Station Endorsement, Public Acceptance." Discussion following this paper was by Messrs. E. I. Sifton and E. M Ashworth.

Mr. P. B. Yates, manager, Public Utilities Commission, St. Catharines, read a paper on "Comparative Operating Expenses". Discussion following this paper was by Messrs. W. R. Catton, D. J. McAuley, E. M. Ashworth, E. I. Sifton, R. C. McCollum, G. H. Long, R. T. Jeffery and C. A. Maguire.

The convention adjourned at 4.50 p.m.

The register of delegates shows a total of 309, classified as follows:—

Class A	93
Class B	70
Commercial	82
Associates	31
Visitors	33

The hotel register showed the total number in the party attending the convention, which included those accompanying delegates, to have been 414.

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in June, 1926.

Appliances

S. F. Bowser Company, Limited, 52-68 Fraser Avenue, Toronto.

Motor-driven Gasolene Pumps. "S. F. Bowser".

* * * *

The Gurney Foundry Company, Limited, 500 King St. West, Toronto, Ont.

"Gurney" Electric Ranges, Style Nos. 100, 503 and 1005.

* * * *

Magicoal Electric Fires (Canada) Limited, 291 Mountain St., Montreal, Que.

"Mulparvo" Combination Air Heater and Table Stove.

* * * *

Signal Electric Mfg. Co., Menominee, Mich.

Portable Electric Fan. "Signal Jr."

* * * *

J. A. Tapson, 126 Huron Street, Woodstock, Ont.

Electric Mantel Grate—Lamp Type.

* * * *

*BRENKERT LIGHT PROJECTION Co., 29-49 Cortland Ave., Detroit, Mich.

Theatre Spot Lamps.

Marking: Rating and manufacturer's name moulded in cast iron of enclosure.

* * * *

*CHRISTIAN ELECTRIC CO. OF CANADA, LTD., Windsor, Ont.

Water Heater—Storage and Circulation Types. Types A, B, C, D, F.

Marking: Nameplate bears manufacturer's name and rating.

* * * *

*WOHL & CO., M. J. INC., Payntar Ave. & Hancock St., Long Island City, N. Y.

"Duplex" Photo Studio Lamp.

* * * *

HOME ELECTRIC, LTD., Quebec, Que.

Pressing Iron "Cid".

* * * *

TRIPLEX ELECTRIC CO., 130 Wellington St. W., Toronto.

Pressing Iron "Triplex".

* * * *

Switches

THE LESLIE ELECTRIC CO., 74 Grange Avenue, Toronto.

"Leslie" Resistance Appliance No. 2.

* * * *

HONEYWELL HEATING SPECIALTIES CO., THE, Wabash, Indiana.

Oil Burner Safety Control.

Marking: "Type B" on etched nameplate attached to stack thermostat unit; "Type DSS" on etched nameplate attached to motor switch housing.

* * * *

MUTUAL ELECTRIC & MACHINE Co., 7610 Jos. Campau Ave., Detroit, Mich.

Combination Switch and Cutout Base. Cat. Nos. SG60F, SG60S, SG30F, SG30S.

Marking: "Bull Dog Saftofuse" with name and rating.

* * * *

PENN ELECTRIC MACHINE CO., Des Moines, Iowa.

Automatic Switches—Pressure-Operated Type. Types DR, RV, HP, RA.

Marking: Nameplate with ratings attached to case.

* * * *

TAYLOR ELECTRIC MFG. CO., LTD. 526 Adelaide St., London, Ont.

Panelboards. "F. A. Safety". Types TP, TPD, NTP, NTPD, TC, TCD, NTC, NTCD, R, NR, R3G, NR3G, 2P, N2P.

Marking: Nameplate with rating.

* * * *

Fittings

THE CROUSE HINDS COMPANY OF CANADA, LIMITED, 7-11 Labatt Avenue, Toronto.

Porcelain Base Rosettes. Cat. Nos. 1700, 1701, 1703, 1711, 1713, 2700, 2701, 2703, 2711, 2713.

Medium Base Receptacles, Cat. Nos. 1706, 1707, 2706, 2707.

Receptacles with porcelain bodies, Cat. Nos. 1705, 2705.

Polarized Receptacles, Cat. Nos. 1708, 2708, 1718, 2718.

* * * *

J. R. FERGUSON, Galt, Ont.
Cast-iron Outlet Plates. "J. R. F. Galt."

* * * *

*RODALE MANUFACTURING Co., 492 Broome St., New York, N. Y.
Adjustable Strap Support for fixtures. Cat. No. F-8.
Marking: Manufacturer's Name and Cat. No. stamped on device.

* * * *

*ERIE MALLEABLE Co., Erie, Pa.
Malleable Iron Conduit Fittings.
Marking: "Kondu-Box".

*WIRT Co., (Mfr.) 5221-27 Greene St., Germantown, Philadelphia, Pa.

BENJAMIN ELECTRIC MFG. COMPANY OF CANADA, LIMITED, (Submittor), 11-17 Charlotte Street, Toronto.

Wall Bracket, porcelain. "Dim-A-Lite."

* * * *

*These devices are under the Underwriters' Laboratories re-examination or Label Service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

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Per Year

"Listening In"

"LISTENING IN" is becoming so popular with Radio fans that general use should be made presently, in a practical way, of this ear-training, in picking up difficult audible records and in making comparisons of various noises and of the changes in the sounds emitted by machinery in motion.

In Ontario municipalities, where water is being supplied on the flat-rate system, consumers may be familiar with the experience of being advised by the Waterworks Department, over the 'phone, that a tap has been left running or leaking in the house during the night, or that a washing-machine driven by water from the town's mains, has been used without a revision of the flat-rate to cover such power appliances. No representative from the Waterworks Department has, perhaps, been in the house for several months and yet the statements that come in over the telephone are correct. An aquaphone or some similar instrument has, during the night, been applied to the service pipes entering the building and the noise made by water running through a leaky tap, or through some machine, has been picked up with sufficient accuracy to warrant the telephone message.

On board that ocean greyhound, the Mauretania, a similar procedure may be observed. While most passengers at the time of leaving shore are on deck to watch the changing panorama as the land recedes from sight a "Listening Brigade" is busy in the turbine room below. Practically the whole engine-room staff may be found with ears close to various parts of the great steam-turbines—70,000 horsepower or more—as they are being "warmed up" for the four or five day dash across the Atlantic. Each official will have an ear-piece which looks much the same as a telephone receiver, and just as a doctor with his stethoscope searches the chest of a patient for râles, pneumonia

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rubs or other unnatural noises, so the engineers go minutely over these powerful turbines listening for new sounds such as will occur if some of the half-million turbine blades become displaced or loose. Such examinations, after the operators have become familiar with the normal sounds as the result of experience, may easily result in preventing trouble and loss by the discovery of defects before they become serious.

Another "listening-in brigade" may be observed during the summer months going from tower to tower of the great steel transmission lines, throughout the province, inspecting and examining closely the life characteristics and expectancy of the enormous number of porcelain insulators on these structures which, in some cases, aggregate as much as a ton-and-a-half of insulating material. All these, and many other inspections, are carried out in an effort to guarantee service during the succeeding twelve months. The procedure in this case also is very like that of the family doctor with his stethoscope and, curiously enough, there is a likeness even in the name of the instruments. A word has been coined which most satisfactorily describes one piece of apparatus which is used in testing insulators—The "Statiphone."

No doubt the day is not far off when systematic "listening in" on all kinds of machinery will be a common daily procedure, just as operators who have become familiar and almost intimate with large important machines have a habit of placing a hand on some essential part to feel the pulse, as it were, of the machine and observe variation from normal conditions.

Devices of this kind have been made use of at sea, a number being specially devised during the Great War for detecting the approach of submarines, and other purposes. They have also been employed in mining disasters to ascertain whether any entombed miners were still alive while attempts at rescue were in progress.

Other practical applications of "listening-in" will, no doubt, be found as the benefits become more evident. For instance, careful checking of the noises in communication circuits, and of that natural hum or tone of wires which has been heard by all who have walked along-side a telegraph line on a frosty day, may result in early detection of faults which may be developing.

Application of Hydro-Electric Power to Farm Work

Article No, 2.

IN the June issue we submitted information on the uses of power on the farm where, apparently, from the records, the greater use was made in the barn.

In this article we submit the details of installation and uses of the farm of Mr. B. L. Siple in the Woodstock Rural Power District. The installation on this place consists of—

Lighting	725	Watts
Range	7700	"
Electric Iron	600	"
Washing Machine	186	Watts
Motor for pumping purposes superseding the windmill	746	"
Total	9957	"

The rate in this district is 90% of the standard rural rate.

Service Charge:

$4.10 per month.

Consumption Charge:

4c. for the first 42 kilowatt-hours.

2c. for the balance used in any month.

Fig. 1. Installation in kitchen. All cooking throughout the whole year is done on the Electric range.

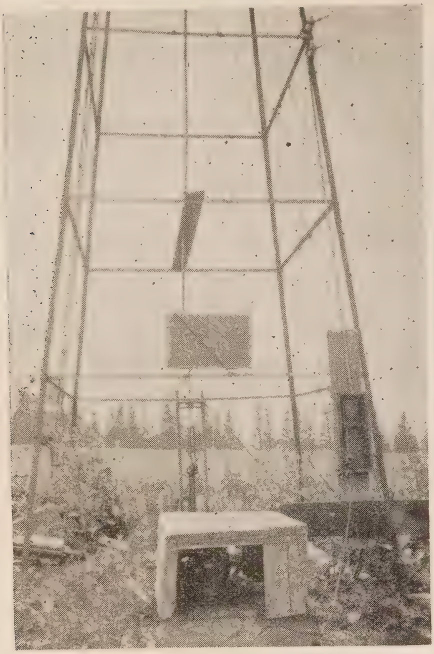


Fig. 2. Pumping motor in housing under windmill tower.

Less 10% for prompt payment.

The service is Class 3. During the year ending March 31, 1926, the consumption was 3246 kilowatt-hours and the net cost $117.60. The current consumption during the year ending July 1, 1924, was 2343, therefore, the consumption has been increased slightly.

All the cooking throughout the whole year is done on this place by an electric range, shown in Fig. 1. The family consists of Mr. and Mrs. Siple and occasional hired help.

Fig. 2 shows the pumping motor installed under the windmill tower in the water-proofing housing with a control switch conveniently located close to it.

Fig. 3 shows the assembly of farm buildings and the main switch and meter are located in the box showing plainly under the trees on the pole. The detail of this is shown in Fig. 4 with the door of the meter box open. The lines from this pole radiate to the house, to the barn and to the transformer on the road.

This is one of the farms in which Senator Norris, of Nebraska, on his visit to this district while accompanied by one of our Engineers, took a great deal of interest. The home is quite modern including a fully equipped bathroom. The water supply is rain water gathered from the roof of the house into a tank which supplies a static head for such service

Fig. 3. Assembly of farm buildings. Box containing main switch and meter is shown near the centre of the picture.

Fig. 4. Distribution pole with main switch and meter box.

New Radio Link

The *Bulletin* has received the following radiogram from Cameron Falls over the Commission's radio system communicating between the Toronto Office and the Cameron Falls Generating Station.

"The Commission has just installed two Experimental Short-wave Radio code stations for direct communication between its Toronto Office and the Cameron Falls Generating Station, on the Thunder Bay System.

"The first two way communication was established August third, and it is intended to use these stations daily for important messages relating to operation, construction, or municipal matters.

"The wave lengths at present assigned are: 29.94 meters for operation in daylight, and 50 meters for use at night."

An article descriptive of the system will appear in an early number of the *Bulletin*.

Electrical Refrigeration, General Development, Central Station Endorsement, Public Acceptance

By Gordon W. Kingsbury, Advertising Manager, Kelvinator of Canada, Limited, London, Ont.

(Read before Association of Municipal Electrical Utilities at Bigwin Inn, Muskoka, Ont., June 25, 1926)

IN discussing electrical refrigeration, the most logical step is to take a glance at its history, and to simplify it for you. It divides comparatively into three parts: the history of electrical refrigeration up to the time of the war, the history of it from the time of the war to 1923, and the history of it from 1923 until this moment. Lord Kelvin was responsible for the original studies in electrical refrigeration prior to the time of experimentation by certain companies, and it is the laws and conclusions that he reached that have been a guide to the experimentation which has followed. Lord Kelvin left a legacy to the human race which will mark our progress, mark our care of food and mark the development of the electrical industry in generations to come. His work was followed in this country for a period of twelve years prior to the opening of the war with experimentation and struggles that few businesses have known. It was a total period of twelve years that consumated the experiments that brought forth the successful electrical refrigerating machine. One organization spent about a year before the first machine would really operate. When they got all through and discovered that everything was all right except the thermostat, they went to the General Electric Company who were specializing in thermostatic experimentation and said, "Please give us a thermostat that will work on this machine." The General Electric Company said, "We have spent $150,000, and we are sorry to say we haven't any thermostat;" so this company started all over again, and after the expenditure of another $150,000 and another six months of time, a thermostat was arrived at, and to-day, you can have in your home a machine which operates automatically, needs oiling about once in thirty days, not oftener, and needs defrosting about every thirty days, and that is, possibly, all the attention that it requires, unless some major trouble comes up in the course of a four or five year period when the oil needs changing in the compressor.

I don't like to hear people say that an electrical refrigerator needs absolutely no attention. A perpetual motion machine has never been invented, and it never will be, but electrical refrigeration has reached the point where it is so efficient and so simple, that it

presents a very simple problem to people who are merchandising and handling it.

The second period in the history, from the war to 1923, saw, as you men know only too well, a serious and difficult problem in the electrical fields. You were faced, immediately following the war, with a shortage of maids—I say a shortage of maids because the shortage of maids had a serious effect on your business. Housewives in this country could not get the domestic help that they wanted, and they solved part of their problems by buying washing machines. Statistics will bear me out in saying that there was an enormous demand for washing machines following the conclusion of the war. With this demand for washing machines and a higher demand on the current which you were producing came the very serious problem, and the headlines in the papers were, "Electrical Men decide not to have an Exhibit, because they cannot spare the juice." It was actually because there was such a demand for electric power that electrical companies' exhibits and shows were called off, because the additional current could not be spared to operate the exhibit, and that existed up to about 1923.

In 1923, a new phase entered into the problem; in the first place, money was easy; money rates were low; the big electrical organizations saw an opportunity to float bond issues, extend their lines, increase their power producing facilities, and you faced a situation of having a power service to sell. You were ready to merchandise power. The housewives of this country were still short of maids. They were welcoming any opportunity to save on labor, and you saw the opportunity to merchandise to people the electric refrigerator, which saved in labor and produced a revenue and used the power service that you had to sell. In 1924, 24,000 electrical refrigerators were sold. In 1925, 75,000 electrical refrigerators were sold; and in 1926, it is estimated that from 200 to 250 thousand electrical refrigerators will be sold, with the result that the expenses you men have had of billing out a $2.00 or $2.50 electric light bill won't be increased at all, and you can bill out, where you are billing for electrical refrigerators, an item of $3.00 to $5.00, at the same expense you have had.

Electrical refrigerators offer you the opportunity of selling extra current, of getting in additional revenue, without materially increasing your expenses. Briefly, there are four things that electrical refrigeration offers you, gentlemen; first, you find that it requires no extra investment in power producing machinery; second, you find that it offsets your winter light load by carrying through the summer a consumption of juice; third, you find there are no peak loads; an electrical refrigerator runs day and night, intermittently of course, with loads which are very even. A few years ago, there were less than six manufacturers of household electrical refrigerators. To-day there are perhaps fifty companies making these machines or planning to make them, and the number is rapidly growing.

The six major electrical refrigeration companies, have co-operated in what is known as the Electrical Refrigeration Council, and they have decided to stop cutting each other's throats and to co-operate to the end that the countries on this continent may be educated to a better appreciation of what electrical refrigeration means. This Electrical Refrigeration Council has appropriated a budget of $100,000 for advertising electrical refrigeration, and beginning with June 5th of this year, there is coming into the Dominion of Canada every month 250,000 full-page advertisements in the Saturday Evening Post, not advertising any particular machine, but setting forth their virtues and the advantages of their epoch making industry.

Another thing that electrical refrigeration is doing for the people of this country is an education for better refrigerators. One of the head doctors in the American Medical Association, Dr. Williams, made an investigation of two hundred and forty-three machines, and he found in that two hundred and forty-three machines, seventy-five different makes of refrigerators, and in testing the efficiency of those two hundred and forty-three, he found that they averaged 80 per cent. inefficient. That is, 80 per cent. of the ice consumed by those refrigerators was to cool the air that leaked in through the doors instead of cooling the food that was in the refrigerator, and the seriousness of this situation is indexed by the fact that the refrigerator manufacturers are combining to the point where they are making their own cabinets and where they are urging the buyers of electrical refrigeration to buy cabinets that are thoroughly competent to keep out heat and retain cold.

Being very much interested in the advertising of this industry, I want to refer back a moment to this Electrical Refrigeration Council. Many of you men are merchandising electrical refrigeration machines, and I want to set forth four points that I think are the principal things to advertise and talk in this merchandising. The first is food preservation; most obvious, because that is the fundamental purpose of a refrigerator. The second is economy; we say electric rates are low; you can actually operate an electrical refrigerator for less money than you can an ordinary ice box. Furthermore, you can buy food in larger quantities; if you are out of town for over the week-end, you may fill your refrigerator, before you go, and come back to fresh milk, fresh meat, fresh vegetables, without any effort on your part. I think it is one of the greatest advantages that you may leave town and come back to a larder that is well kept and well preserved, and you can sit right down to a meal, just as you would like it. The third point is convenience. Obviously, a machine that requires little or no care is more convenient than the type of refrigeration which requires replenishment at least every forty-eight hours. And the fourth and last point is one which is very ethereal but very important, and it is the point of pride of ownership. There isn't a housewife that owns an electric refrigerator that doesn't, with pride, show the guests in her

home the refrigerator in her kitchen, and if this human motive is appealed to in your selling effort and in your advertising, you will go a long way towards convincing her of the merit of the machine you have to sell.

It is very interesting to study the future, or to prognosticate the future of this business. It is very absorbing. We people who are engaged in it, think nothing of time; we think only of accomplishing the thing we are trying to do. The future of the industry can only be compended in a very, very rough way; for example, there are 17,500,000 automobiles in the United States, and yet there are only 7,500,000 people with an income of $1,000 or over, which shoots all to pieces any argument you might have that a person has got to have a certain income before he can buy an automobile. We are conservative enough, in the electrical refrigeration field to say our possible market, however, is limited to the people who have a certain income, and we set up, in the United States, at the Government reported income of $3,000, which makes a gross income usually of about $6,000 per year. We feel that any family that has that income is a logical prospect for electrical refrigerators. In Canada, you have something that the United States doesn't have, and that is a wider spread use of electricity. Instead of having only about forty-five or forty-eight per cent. wired homes out of your total number of homes, you have a larger percentage. You start from scratch with a bigger advantage than the United States starts. You have in Canada about one hundred and fifty to two hundred thousand people, who are eligible prospects for electrical refrigeration as far as their income is concerned.

1924 showed the most wired homes —I mean by that, taking the country at large,—the peak in the wiring of homes already built was reached in 1924. The curve has started to drop. You will always have, as a future market, for electric wiring, the new homes built, but the number of old homes that you will wire is fast diminishing. Your future revenue must be looked to from the point of getting more load on the wires. You already have places getting a larger billing from the homes that already have electricity in them. Your future market in selling your merchandise needs to look more to the profit from the current you sell than from the merchandise, electrical refrigerators, stoves, or whatever it may be, that you may be selling. As I see it, your future lies in the profit you will make from the sale of the power you have to sell. We are geared up in the electrical refrigeration industry something as Andrew Carnegie operated in the steel business, and I would like to digress just a moment to give you a little contrast I heard the other day between those famous men, Mr. Stines, of Germany, and Andrew Carnegie. Carnegie made a total of three hundred and fifty million dollars before he died; but, in the making, gentlemen, he made forty-three millionaires. Mr. Stines made a personal fortune of about one hundred million dollars. He ran his business himself; and when he died, he left it all to his wife and his two boys, and in the

course of six months his entire fortune of one hundred million dollars was dissipated.

Now the electrical refrigeration industry, by coming together, by working together with you men, is operating on the Carnegie plan of organization. We have not yet made many of the forty-three millionaires, but the refrigerator companies that are established are successful, and many, many are the chances that the people who see the vision of this industry and climb on the band waggon are going to make some money and be on the road to be one of those forty-three millionaires. I hope you get the simile. It seems to me it is a strong deciding difference between where electrical refrigeration as an industry is starting out to operate and the difference in which other organizations have started. The McGraw Hill Publications have said that, next to the manufacturer, the central station profits must prove the sale of electrical refrigerators. These are days that are changing and changing rapidly. I use the expression, in my own department, we have got to shift gears. We have got to speed up our operations.

Accident Prevention and the Workmen's Compensation Board

By V. A. Sinclair, Chairman, Workmen's Compensation Board

(Extracts from address before Ontario Municipal Electrical Association and Association of Municipal Electrical Utilities at Bigwin Inn, Muskoka, June 25, 1926.)

THE workmen's Compensation Act was passed about 1914, just before the War, and commenced operations on the first of January, 1915. It was the result of Sir James Whitney sending Chief Justice Meredith to different countries where they had Workmen's Compensation Acts and endeavoring to get the best that he could out of each Act then in force. The result was that we have very largely the law of England, so far as relates to the Act itself; but so far as relates to the payment of moneys, the assessment system and collecting moneys to carry on the Board, it is United States system; so that the two systems have been combined into the present Ontario Workmen's Compensation Act.

During the time this Act has been in operation, I may say that there has been spent fifty-one and a half millions of dollars in payment of compensation. During that time, over half a million—five hundred and two thousand claims to be exact—have been dealt with by the Board in awarding that amount of compensation.

The employers of labor in the Province of Ontario are divided into about four classes. We have those who are not under the Act at all; we have those who are under collective insurance; we have those who pay as they go, and we have the Crown represented by the Ontario Government and the Dominion Government, to whom we also give compensation.

Now, the largest classes outside the Act altogether are the farmers, those engaged in husbandry, those engaged in wholesale and retail trades, wholesale and retail trade stores, all of whom are exempt unless they are part of a manufacturing concern. There are also a number of classes kept outside of the Act by reason of regulations passed by the Board. That is, it would have been very hard to find out all those people carrying on small operations, and therefore the Board, by regulation, said, "Before you can come under the Act, you must have four employees." In some cases, it is six employees.

Schedule 1 is the largest Section of the Act, and comprises those who are under collective insurance, and pay an assessment. That assessment is collected annually, and is just sufficient, so far as possible, to pay the claims for that year. I may say that in the past year, our estimates were so close that we only collected about one hundred and fifteen thousand dollars more than was sufficient to pay the claims in that particular class, and that is about as close to safety as you can run, where your claims and the amount of your liability are apt to be very vague. You don't know when a claim is going to end, or how much you are going to have to pay.

Schedule 1 employees are divided into twenty-four classes, which are largely Mutual Insurance Societies, as you might say. They are divided so that there will be a sufficient payroll to make it carry itself without any appreciable effect. The class to which most of you belong is Class 22, and has the smallest payroll of any class in connection with Schedule 1 of the Act. In that class, we have a payroll of about four million, two hundred and fifty thousand dollars. During the past year, the total payroll in Schedule 1 ran about three hundred and ninety-six millions.

The system needs explanation in so far as the electrical workers are concerned, because, by law, you are put under Schedule 2; that is, those who pay as they go. In that category we put the large Railroad Companies, Steamboat Companies, Express Companies, Telephone Companies, and Municipal Corporations and Commissions carrying on that kind of work. They are all under Schedule 2. But a great many have seen fit to go into Schedule 1. Out of the three hundred and seventy-six employers in Schedule 2, two hundred and fourteen of those come from Municipalities and Commissions and asked to come under Schedule 1 of the Act. Now, I think those who come under it are wise.

If you go to an Insurance Company, (and there are some writing that kind of insurance) and ask

for covering for your Workmen's Compensation liability, I understand the rate they would ask is two and a quarter per cent., or $2.25 for every hundred dollars of payroll to give you the full covering that the Workmen's Compensation Act gives you. We have been charging, for the last three years, a rate of $1.75 per hundred, or about fifty cents per hundred less. Now, you have the advantage in that you have no worry about the size of an accident, because that is going to be absorbed by the collective insurance of that whole class, and you know definitely, when you are assessed $1.75, that if you have an accident that may involve $25,000 of liability, it is not going to raise your rate excepting as the class rate might be raised by too many heavy accidents.

During the year 1924, which is the last year for which we have absolutely accurate figures in connection with Class 22, they were about $24,000 behind in meeting their claims. That is, their assessments were $24,000 less than was paid out in compensation and medical aid. But for the past year, in so far as we can estimate, you are about $20,000 ahead, so you are now in a minus position of about $4,000 as a result of those two years work. It is not the policy of the Board to change the rates up or down with every fluctuation, if your accident experience has been good for a number of years and your rate appears to be safe. If you have a very bad year, we don't jump the rate up at once. We try and see if you won't recover. If we see that the tendency is to go back again to par shortly, we will carry the minus classes out of the surplus in the other classes, without any increase in the rate.

You have no worries if you come under Schedule 1. If you are under Schedule 2, you may have a claim which will run from twenty to twenty-five thousand dollars. That is about the heaviest claim that you can be put into, under Schedule 2. You have no expense at all if you have no accidents; but you have always got the risk, and if you should be hit for a $20,000 claim in any year, it will wipe out a great many premiums that you would have paid in a number of years before. So I think those Municipalities operating Public Service Commissions would be wise to come under Schedule 1 of the Act by application. If you do, you will have a set rate which will grow less if your accident experience entitles you to it.

I may say that last year, in connection with compensation, we paid out five million five hundred and sixty-five thousand dollars for the year. Out of that, Schedule 1, people paid $4,500,000, or about $1,000,000 less than the total amount. The other million dollars was accounted for by Schedule 2, the people who pay as they go.

We had this last year a little over sixty thousand claims. We averaged about two hundred fresh accidents every day, taking the working days of the year throughout; some days I have known them to run up as high as nearly five hundred fresh accidents notified in one day. We issue at least six hundred to eight hundred cheques every day. During the month of April, they ran

about seven hundred and twenty-five cheques every day, going out for compensation. We receive and send out about four thousand five hundred letters every day. The man who has charge of that Department said that the change in the postal regulations, by the lowering of the postage, would be a $5,000 saving in our postage bill during the coming year; so that we are hoping to decrease the administration expense somewhat in that way.

We are very proud of our administration cost, because it has been carried on, I think we can say without contradiction, the most economically of any Compensation Board that is being operated. In some of the Compensation Boards, out of every hundred dollars which they pay, they collect sixty per cent. of that for expenses, or $40 goes to the workman, and $60 goes to the expense of administration; but in our Board out of every $100 we receive, between $4 and $5 goes for administration cost, and the remainder, $95 or $96 goes to the workman. That is the result of the very efficient administration of the administrative system which was put into force by the late Chairman, Mr. Price. While Sir William Meredith was entitled to the credit of bringing in and devising the Act, the making of a live, economical and effective administration, is the result of the work of Mr. Price. No more efficient, no more self-sacrificing public servant has ever been in the Province than the late Mr. Price, who gave his life for the work of the Board, which is a continuous, every-day administration of claims.

If you ever let the mill stop and your two hundred claims a day accumulate, you can understand that your mill would be very quickly clogged and your business would be in great trouble. We have a very unselfish staff who are all imbued with the idea that they are public servants, and that, when the day is done, the work must be wound up so there won't be any delay in sending out the claims and the cheques to the workmen who are so much in need of them. We make a boast that, within two days after the completion of the papers, the cheque is in the hands of the workman or on its way to him.

There are a great many misconceptions about what the object of the Act is. It is thought that, because a person is disabled, he is entitled to compensation. That is not the case. It must be the result of an accident, and the accident must arise out of his employment. Many cases are on the border line between sickness and accident. We are not a Sickness Board. You all know the difference between your insurance for sickness and your insurance for accident, and the difference in rate; and if a man gets a dose of lumbago, while in his employment, he is not entitled to compensation. We will have a workman leaning over. He gets a stitch in his side, and he thinks "I am entitled to compensation." The Doctor says he has got a sacroiliac strain. Unless it is pretty well confirmed that it is the result of an accident, and not due to constitutional conditions, the claim will be thrown out as being due to a con-

stitutional condition and due to sickness but not an accident. Then you have dissatisfaction among your employees, because they don't get awarded a claim. Then you have another class of accident where, by reason of a man doing something continuously, he may get a disability. He may continue working at something until he gets a sprain in his wrist, and there is a swelling there and he thinks he ought to be compensated because he has received the swelling from his employment. That really is not an accident. It is due to conditional occupation; and unless it comes by reason of an injury, he will not get compensation because he didn't have an accident. Then you have the standard case which is causing some difficulty, that is the hernia case, and Doctors tell us that probably ninety-nine out of every hundred are not the result of accident at all, but the result of constitutional conditions; so when we deal with hernia cases, we have to enquire very carefully to see if there is an excuse to call it an accident, because I am firmly convinced that there are not very many accidents that cause hernia. We have probably more trouble with hernia cases than anything else. We have certain standards which we require before we allow a hernia claim, because it is very near the sickness line, and so far the Legislature have not put hernia cases on the industrial sickness list.

We have, in industrial diseases, such things as poisoning from lead, poisoning from mercury, and other kinds of poisoning. We also have recently in the mining field what they call silicosis, which is caused by dust from silica, and it is said that, during the present year, we will be called upon to pay, in the District of Porcupine alone, from half a million to three-quarters of a million in claims for silicosis. The same thing occurs in plants where they grind metals; they have an affection of the lungs caused by the silica used in connection with the grinding.

The principle which we follow is to make every year pay its way; and so we estimate each year what the accidents will amount to in that year. Just as long as a man is totally disabled and is under the Doctor's care, we give him two-thirds of his wages. During that stage, we pay his Doctor's bill, pay his hospital bill, if necessary, and if a specialist says that some kind of operation would aid the workman, or do him good, we pay for it. We do everything we can to restore him to work as a workman and bring him back and rehabilitate him. That is what we call the temporary total disablement. Some times, the Doctor will say, "he is ready for light work. He can take a sitting down job or something of that kind." When he gets to that stage, we say, "You can only have a certain percentage of your total disability," and we may award him that, and carry him along that way until he gets back to where he can earn his regular amount. But when he gets to the point where the Doctor says he can do nothing more for him, we give him a permanent disability. If that exceeds ten per cent of disability

it is given by way of a pension for the balance of his life, and not in a lump sum. The object of this is that a person who is handicapped in the labor market is going to have that handicap all through his life. If he receives it in a lump sum he is going to use it up, nine times out of ten, and in a few years you have a disabled man who has nothing to compensate him for his disability; whereas, if you continue it throughout his life, he will have his $25 or $10 a month, just as long as he lives. It is in very exceptional circumstances that we ever commute these pensions, as we call them, into lump sums. We have done it in some cases, and in nearly every case, we found the money was dissipated and the man no further ahead.

I said before that an accident had to arise out of the employment. If you are not working, your employer should not be made to pay for something which is not part of your employment. You have to look at the other side,—who is paying the bill. It is very nice to be generous; but if we were generous to the extent of $1 in every claim that comes in, we would spend $60,000 a year in charity. So you have to put a limit to your generosity and deal with it fairly.

One of the other things which was to be in the address I was to give you was the matter of Safety and Safety Associations, and I might just say a few words on that. Safety Association work is not work which is left with the Board. We pay the bill, but you pay it again to us. The particular class meets—that is, your Class 22, and if they have a substantial meeting, which the Board consider is sufficient to represent that class, they appoint a Board of Directors for safety work, and then they come to the Board and say how much they want with which to carry on that work. Your Association gets $6,000 a year for the purpose of carrying on that safety work. We leave that to your Directors to carry on.

But there is not any more important work than your safety work. It is a peculiar kind of work, because you do not see any returns. You know the number of accidents, but you don't know how many have been prevented by reason of safety work, and therefore you have to guess at the result of the work. When you see 60,000 accidents in the year, and that they have to be taken care of, before you think of the Safety Association, you may think the expenditure has perhaps been wasted. But I wouldn't think that of it. We had more accidents last year, 1,300 more than the year before. The compensation was half a million dollars, which would go to show they were less in severity and less in absence from work, both of which reduced it, possibly due to the effect of good accident prevention. We do know that the number of accidents which arise out of handling machinery is decreasing. The percentage of accidents arising from the handling of machinery, the lack of guards, and that kind of thing, is decreasing. So there are positive results in that way.

But there are a great many other accidents which are really accidents. They just happen, and you don't

see anything which could have been done that would have prevented them. So you have to imagine a great deal of the good effects of your safety work and imagine what it would have been if it had not been there. Now, if you make your safety work really effective, one hundred per cent. effective, of course you would not have a Compensation Board, because you would have no accidents. But there are certain accidents which I think will continue to happen until the end of time. One of the Safety Association men in the Pulp business was telling me he was going to put us out of business. Why, they were going to be so safe there would be no Workmen's Compensation Board, and I said, "All right; go to it! We will be very glad to assist you as much as possible." But accidents still continue to come in just the same.

When you have an accident, you must have the appliances which the Board say you must have, your safety kit, and it is wonderful how infection is prevented by the application of disinfectants at the early stages of injuries. We see people come in with infected hands, from little cuts, especially up in the lumber woods where they have not had medical attention. They lose an arm, or a leg, from nothing but a small scratch or cut which could have been prevented altogether if they had taken the pains to put a little iodine on and disinfect the wound. I cannot impress too strongly on you the necessity of having your first aid kit in operation, and to have somebody that sees to its operation. It is far better to be overcautious and stick on the iodine and the disinfectant and prevent, as much as you can, the increase and the effect of the accident in that way.

Where you are pretty well in touch with your men, you have an opportunity to see that that part of the work is looked after, and that the first aid kit is there and is used. There is another thing. It is very much better to try and get the man back to work just as soon as you can, even if he is not doing one hundred per cent. work and you don't feel you are getting one hundred per cent. out of him. Take him back to work and keep him going, because you can just figure it out—if you are going to pay 66-2/3 per cent of his wage through the Board, you are going to pay the Doctor's bill and the Hospital bill, if he still continues on in Hospital, as many of them do, using it as a boarding house. You are going to have something out of your hundred cents on the dollar, even if you just make the man walk round the plant with a broom in his hand; and besides that, you keep up his morale. The longer you leave a man unemployed and drawing compensation, getting something for nothing, the more you spoil him. I don't say he should be taken back to work before he is fit, but get him back as soon as you can and preserve his morale, and by doing that, you are going to reduce your accident cost a great deal besides turning out a very much better workman. I think there is a responsibility by the employers to the people who have been damaged in their service. Your first duty is to the man who was

injured in your employ. If you shirk it and turn him off, you don't need to expect other people are going to take on a cripple, unless they have a great deal of charity in their composition.

Process for the Manufacture of Alkali-Chlorine Products

By D. A. Pritchard, Works Manager The Canadian Salt Company Limited, Windsor, Ont.

THERE are two factors of great importance that govern the selection of a site for an electrolytic alkali-chlorine plant. These are cheap salt and cheap power. Underlying the southwestern section of Ontario and portions of Michigan are salt deposits of vast extent in the salina formation of the Silurian Age. The approximate area of this salt basin in Ontario is about 3,000 square miles. The salt beds vary in thickness, the upper and thinner layers being interstratified with dolomite and shale. In the salt beds at Windsor a log of one of our wells shows the so-called "deep salt" to be 230 feet thick. To give an appreciation of what this deposit means, a block or square mile of it 230 feet deep would contain over 400,000,000 tons. Passing south into Michigan the salt formation continues under Lake Huron, the St. Clair River, Lake St. Clair, and the Detroit River, but 10 to 20 miles from the border it dips sharply and does not appear again except at the edges of this vast basin. The depth of the salina at the center of the basin must be about 4,000 feet. From Detroit to Wyandotte, a distance of 12 miles along the United States side of the Detroit River, are the alkali plants of the Solvay Company, Michigan Alkali Company, and the Pennsylvania Salt Manufacturing Company, having a total daily capacity of approximately 500 tons of equivalent caustic soda.

Fig. 1. Sandwich Works of The Canadian Salt Co., Limited.

Power

The Sandwich works of the Ca n adian Salt Company are at the extreme western end of the Ontario Hydro-Electric Power Commission's distribution of Niagara power, there being 276 miles of transmission lines between Windsor and the Niagara stations. The energy is brought to Windsor at 110,000 volts and delivered to the plant at 26,400 volts, 25-cycle alternating current, where it is converted to direct current at 250 volts. The company buys from the commission 4,000 horsepower and has a steam power plant capable of generating 8,000 horsepower.

Brine Purification

Before the raw brine from the wells can be used in the process, it must be treated to remove salts of lime and magnesium, which impurities would otherwise precipitate in the pores of the diaphragm and thereby increase the resistance of the electrolytic cell. This purification is done by heating the raw saturated brine to 85° cent. and adding to it a calculated amount of

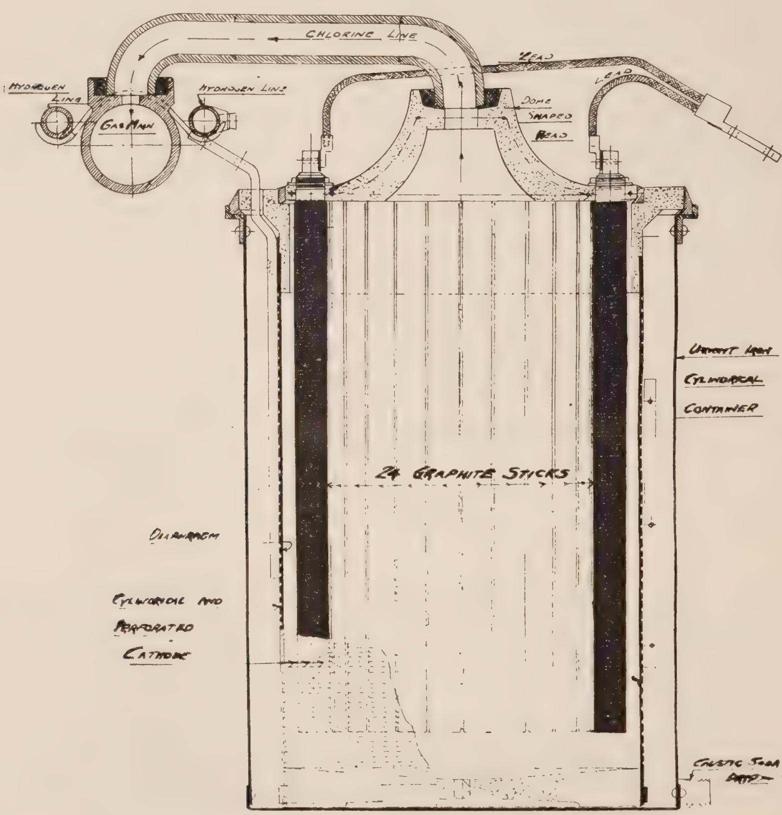


Fig. 2. Section Through Gibbs' Cell.

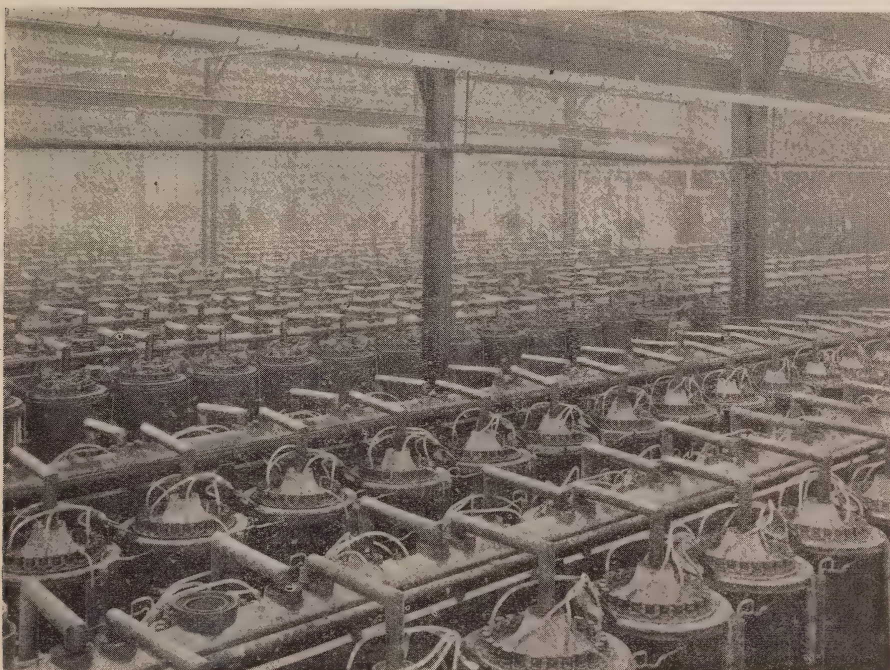


Fig. 3. Cell Room.

sodium carbonate solution containing a trace of caustic soda. The resulting precipitate of calcium carbonate and magnesia is allowed to settle out and the clear, pure, and warm brine run through a settler heated by coils supplied with hot, condensed water from the salt grainers. Settling by mechanical clarifiers or in tanks is quite satisfactory and is a considerable saving in labor and material over the filter-press methods. The reagent sodium carbonate solution is made by carbonating with boiler flue-gas caustic liquor from the cells. This, in addition to being cheaper than using soda ash, gives a more rapid settling precipitate. After the impurities have settled out the brine is again heated to 85° cent. and fed automatically and by gravity to the electrolytic cells, where it is decomposed by the electric current into its component parts.

The Electrolytic Cells

The cells or "electrolytic decomposers" used at the Sandwich plant are of the diaphragm type and are the invention of an Englishman, Arthur E. Gibbs. The process is undoubtedly one of the most efficient of its kind in operation to-day. A large plant consuming about 10,000 horsepower is located at Wyandotte, Mich., and possibly the largest electrolytic alkali installation in the world to-day is that of the United

Alkali Company of Great Britain, both using the Gibbs cell. It was at the former works, the Pennsylvania Salt Manufacturing Company, that the cell was first installed in 1907. There have, of course, been improvements in seventeen years of operation, but the original invention has been faithfully adhered to. Fig. 2 shows the present cell.

The cell itself is inclosed in an upright iron container, cylindrical in shape, and is assembled by placing inside this container a cylindrical and perforated cathode sheet on the inner side of which is secured a diaphragm of a special grade of long-fiber asbestos paper. Inside the cylindrical cathode and as near to it as practicable are placed 24 graphite sticks, 2 by 2 by 36 inches long, suspended in a circle from a dome-shaped head. The head, the ring it fits, and the bottom around which the cathode with its diaphragm is formed are made by the company from a mixture of cement and asbestos. The joints between the various divisions of the cell are so designed that they can be made gastight by a chlorine-resistant putty. These cells are arranged in a series of seventy individual cells placed in two parallel rows of thirty-five each, and are connected so that the current must travel in series through the whole seventy under an applied voltage of 250 volts. Each cell will take approximately 3.57 volts and a current of 1,000 amperes. Practically the only departure from the original design has been in the manner of feeding the brine. Some of the cells are operating with the original under-feed, although the type of feed just described is being installed.

The chlorine gas generated is removed through a pipe connection into a gas main kept under slight suction. The caustic soda, together with some undecomposed brine, trickles down the outside of the cathode sheet to the bottom of the cell container and thence into a receiving line into storage tanks which supply the evaporator department.

The cell operates at a current efficiency of 93 to 95 per cent. over the anode life of better than a year, a power efficiency of 56 to 57 per cent. and a voltage efficiency of 60 to 61 per cent. It will produce in 24 hours, per square foot of floor space taken, 5 pounds of caustic soda and 4.43 pounds of chlorine. The caustic will run 120 grams per liter of sodium hydroxide, and the chlorine 95 per cent. or better. The cell itself is remarkably simple, while the ease of its assembling and replacement does not demand expensive labor in building or supervising while in operation.

The caustic cell liquor is pumped into storage tanks which in turn feed the double effect Scott Evaporators. This process concentrates the cell liquor from about 10 per cent. to 50 per cent. NaOH after which the remaining water is got rid of by boiling off the fusion at 400° cent. in open, coal fired, cast iron pots.

The caustic is then poured with a special centrifugal pump into sheet steel drums for solid, or onto iron trays for broken caustic. There is also special flaking and crushing

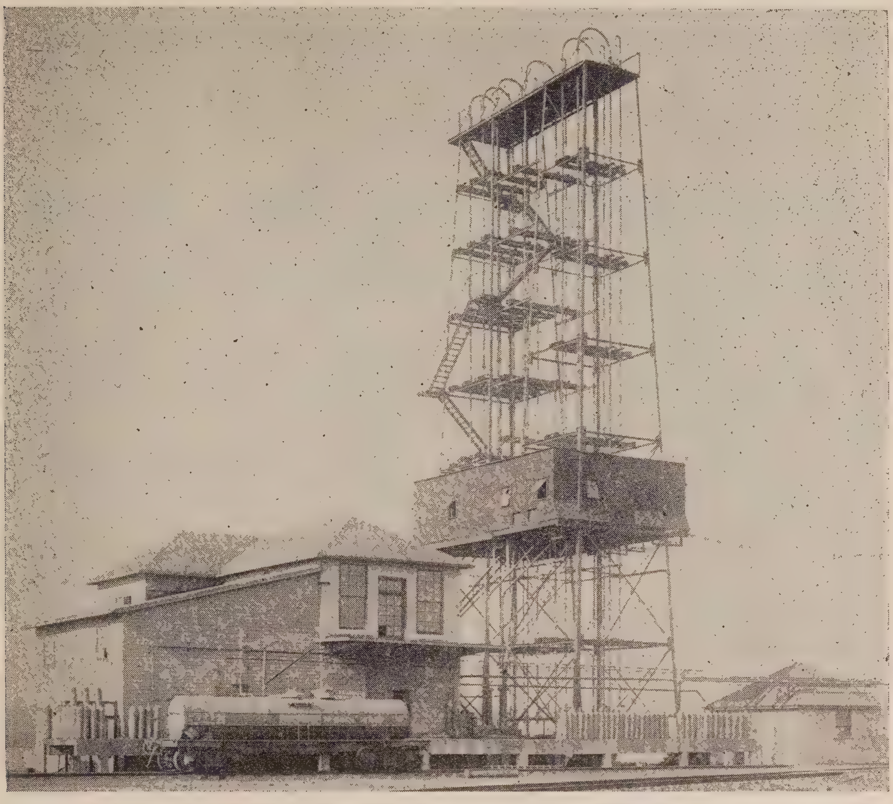


Fig. 4. Liquid Chlorine Plant.

machinery for the production of Flaked and Ground Caustic.

Most of the Chlorine is liquefied by means of low temperature and pressure and supplied to the trade in 15 ton, single unit tank cars and 150-lb. steel cylinders. The tank cars, a fleet of 50 of which are maintained by the Canadian Salt Company, are used chiefly for transporting chlorine to the pulp mills of Canada for bleaching purposes, although a considerable quantity is used in metallurgical processes. Over 5,000 cylinders are maintained and used by the various water works for purifying water, in textile mills for bleaching, and in the bleaching of flour, etc. The chlorine which is not liquefied is utilized chiefly in the manufacture of bleaching powder, Javelle water, etc.

The remaining by-product of the electrolytic cell, Hydrogen, has various applications. It may be used in the hydrogenation or hardening of oils or in the synthetic manufacture of anhydrous ammonia by the interaction of nitrogen and hydrogen. The ammonia may, in turn, be liquefied and sold in cylinders or caused to react with Hydrochloric

Acid for the formation of Ammonium Chloride, with Sulphuric Acid to form Ammonium Sulphate, with water to form Aqua Ammonia, or it may be oxidized by aid of catalysts to form Nitric Acid and Nitrates.

Radio Interference from Power Circuits

By Philip S. Donnell, Professor of Electrical Engineering, University of New Mexico, Albuquerque, N.M.

UP to the present time electric light and power companies have been called upon twice to study the effect of their power circuits upon the electrical circuits of others. The first call came from the telephone companies, which said that their wire lines were picking up through electromagnetic and electrostatic induction the hum of alternating current and that it was interfering with the purposes for which their lines had been constructed. After some preliminaries the companies operating sources of interference co-operated in such fashion that within a few years the general problem of interference had been solved and working agreements laid down based more or less upon the Golden Rule.

Now a second call has arisen, and it is the same cry—interference. Having rid the circuits of the telephone companies of foreign potentials commensurate with the potentials rightfully existing in them, it might have appeared that the trouble was over, but with the advent of radio an entirely new situation has arisen. Voltages, which upon the solution of telephone problems were undetectable, now become annoying due to the extreme, inherent sensitivity of radio receiving sets. In the early days of radio with the crystal and single-tube sets, these voltages, although in evidence, did comparatively little harm, but now with the multiplication of amplification and the desire to pick up weaker and weaker signals from more and more distant stations, the power companies again are confronted with the necessity of making a drastic examination of their lines and equipment to eliminate even the most minute radiations of energy. So sensitive are the radio receiving sets that whereas the telephone circuit was at first the one interfered with now it has joined the ranks as a source of interference.

When it is realized that 10 watts or one ten-thousandth of one per cent of the energy in a 10,000 kv-a. circuit may be radiated from a poor contact or a dirty insulator on a 66 kv. line and that amateurs are using this same amount of energy for transatlantic communication, it is evident that something has to be done. Because of the enormous growth of the radio industry to a point where practically one out of every five homes has a receiving set, immediate action was necessary. So many new problems followed in the steps of

radio development, however, that it is little wonder that some of the most vexing still remain to be solved.

Responsibility.

Without going farther into the history of the development of radio it is sufficient to say that public utilities in general, after some little coercion, have realized the absolute necessity of coping with the problem of interference. There may be some executives who refuse to recognize complaints but they are few. Most companies have realized that there are two important reasons why it will pay to act, viz: (1) the maintenance of good will between utility and consumer which means co-operation and loyalty from the public, both indispensable in these days of regulation; and (2) the development of radio because it means added revenue to the companies in the way of energy sales already estimated at $40,000,000 a year. A careful analysis of the load of fifty customers of an Eastern utility for several months before and after the purchase of a radio receiving set showed that there was an increase in the average monthly kw.-hr. consumption from 31.35 to 43.7 kw.-hr. or 39.5 per cent. From information derived from other sources it may be said that these figures are fairly representative. They represent the increase in domestic lighting consumption which might be expected if every home became addicted to the new fad. The increase is due to two sources, the greater use of lights and in the supply of energy necessary for actual operation of the set through battery charging. This latter load is increasing as newer types of sets eliminate the use of batteries.

There has been a decided change in the percentage of complaints proving to be bona fide cases of trouble since those days two or three years ago when the owner of the radio receiver knew little of the meaning of the noise in his set and less of the theory of its operation. At that time the attitude of the utility companies was one of, "We are not interested", and the public press and radio organizations blamed all troubles on the light and power industry. In those days perhaps fifteen per cent of the complaints was due to causes for which the utility company was responsible; to-day this percentage has increased probably to fifty.

An analysis of complaints made by one large company recently showed the following results:

10 per cent of the reported troubles disappeared before they could be investigated.

10 per cent were due to defects in the complainant's set.

15 per cent were due to grounded street-lighting circuits.

25 per cent were due to loose connections, poor insulation, grounds etc., of power and lighting circuits.

40 per cent were due to a large variety of causes for which the power company in no way could be blamed, such as high-frequency experimenters, electro-medical apparatus, railroad bells, noisy motors, crossing signals, etc.

Interference Classified.

The acknowledged sources of interference are: (1) static; (2) regenerative sets; (3) defective connections in receiving sets; (4) equipment and apparatus connected with utility circuits, operating either normally or in some cases defectively, for the operation of which the company is not responsible; (5) the machinery, apparatus and circuits for which the utilities are directly responsible.

Of static nothing will be said. It is with the radio fan always and does not concern the power company. Of regenerative sets it can be said that careful tests have shown these to be annoying at distances from 50 to 100 miles and it is probable that 25 per cent of the difficulties would be eliminated with the disappearance of this type of set. Of defective connections in the set, obviously it may be said that the power company is not responsible.

The above types of interference again may be divided into two classes, man-made and natural. Static belongs to the latter class. Man-made interference may be divided into three classes: that resulting from high-frequency continuous waves, that from high-frequency but damped waves and that from straight magnetic induction. To the first of these belong sources (2) and (3), regenerative sets and defective connections and operations of either transmitting or receiving stations. To the latter belong sources (4) and (5) which have to do with the public utilities and the equipment connected therewith.

Detection.

The detection of radio interference is accomplished in almost all cases by the use of radio equipment, and several companies already have designed some excellent portable sets for the purpose. The general method is to listen in at various places with a loop antenna and with sets of different types and thus locate the source of trouble by directive reception.

The immediate sources of the energy which causes interference are varied. As has been mentioned, interference may be caused by direct induction but this is local in character and of little consequence. It may be corrected by placing the aerial at right angles to the source of trouble. The sounds picked up usually are the 60-cycle hum or the hum of higher harmonics. The second arises wherever there is a slight discontinuity in a circuit and the contacts are separated by a small distance. An arc is formed and from this arc the energy is radiated in the form of high-frequency electromagnetic and electrostatic waves. These arcs are not necessarily continuous; they may be incipient arcs over the surface of an insulator which has become dirty, or through the cracks of the porcelain. They are nothing but a leakage current changing in magnitude and indicated now and then by a more or less infinitesimal spark. The sounds picked up in this way usually are rough and irregular as they are from radio-frequency oscillations on a circuit which is highly damped because of the high resistance.

Radiation.

If this energy were radiated from the spark alone, the problem of interference never would have arisen because its effect would be purely local and the area affected restricted. The difficulty is that when the arc is formed the conductors leading away in both directions from the source of trouble act as antenna and the energy is radiated from them. If the arc is to ground, there is the antenna on one side of the arc and the ground on the other—the typical arc radio transmitting station. If the arc is between sides of the circuit it is a case of an aerial with a counterpoise.

Were it not for two things the entire interconnected power system would become the antenna. The oscillations in the arc are of high frequency, depending upon the constants of the radiating arc, and therefore leak off through the insulation more rapidly than the low-frequency, low-voltage current. Also the transformers form an almost open circuit to the frequencies in question because of their enormous impedance thereto. If then a source of trouble is in a dwelling, the extent of the territory affected by direct radiation from the arc will be small, but on the other hand the circuit leaving the house will radiate energy as will every house circuit connected thereto, as far as the transformer. Thus the unwelcome noise is carried over a much greater territory than that affected by the radiation of the spark itself.

But this is not all of the story, for if there is an open-wire telephone line not in the form of a twisted pair within 50 or 100 ft. of the power line, it will pick up the energy by induction and carry it to a still greater region. The limits to which it will reach are not restricted by transformers, as in the case of power circuits, but only by the energy dying out due to leakage and absorption. Interference thus may be carried four or five miles on telephone circuits although the telephone company's equipment may have nothing to do with the source of disturbance.

The electric light and power industry, however, is interested not only in possible sources of interference but also in some of the remedies insofar as they have been discovered up to the present. It can be said that there is much information that is not yet available except to those who have made investigations.

Interference Traceable to Power Sources.

The sources of interference with which central stations are concerned directly can be divided into four main sections: power, industrial applications, household appliances, and miscellaneous. These in turn fall into the more detailed divisions treated in the following paragraphs.

(1) *Lines:* Only under abnormal conditions do these originate trouble. There are two conditions, however, which cause trouble, corona and arcing grounds. The corona will occur only on high-voltage lines or systems and is of little interest here. The grounds may occur where cir-

cuits pass through trees or come in contact with guys, or through swinging contacts between the wires themselves. The usual source of trouble is a ground through a tree. The resistance of the tree is sufficiently great to prevent a sufficiently high-current flow to operate the protecting equipment. Yet each time a contact is made with the tree an arc is formed and if the swing in the reverse direction were small the arc might persist. I have actually observed a continuous arc of this type taking place on a grounded-neutral distribution system with a phase-voltage of 2,300. Such arcs as these probably cause the radiation of more energy than any other type, and when they occur on the high side of the distribution transformers it is apparent that there are a good many miles of antenna for radiating the energy.

(2) *Insulators:* Trouble here arises either from cracks or a dirty surface over which there is considerable leakage with incipient sparking. An arc on a 66,000-volt insulator has been known to prevent entirely radio reception within a a distance of six miles during the period of its flashing over. These are more or less rare occurrences as the factor of safety on insulators is fairly high. They are detected easily as the source of trouble radiates such a great amount of energy. A loop with a sensitive receiver set up in several positions away from the transmission line invariably will locate the source of trouble.

(3) *Lightning Arresters:* Obviously the discharges in this equipment are most noticeable during electrical storms when they are in legitimate operation and therefore are not a source of much annoyance. However, the necessary formation of the film each 24 hours in the electrolytic arrester is accompanied by an arc which may be heard anywhere on the system. As this is usually at some hour in the night and only momentary it is negligible in its effect, although often noticed because of the regularity of the charging operation.

(4) *Transformers:* Defective insulation in transformers will cause very severe interference, but as a rule the insulation breaks down completely within a short time after incipient arcing takes place. Regulators are in the same category as transformers, except for the automatic equipment connected with them such as the contact-making voltmeter, relay switches, etc., all of which are sources of energy emission. The suppression of this energy radiation is rather simple as it may be eliminated through the use of chokes and condensing drains to ground.

(5) *Generators, Motors and Synchronous Converters:* On large systems arcing at the slip rings on a generator as a rule spreads little trouble because of the fact that the generator feeds directly into step-up transformers. On smaller systems, where distribution is at generator voltage, arcing at the rings will cause trouble as the high frequency will be picked up by the power leads and fed to all parts of the city as far as the distribution transformers.

Oscillations set up by the sparking at the commutator of a converter

as well as spreading out over the direct-current systems may travel back through the low impedance winding of the armature and out onto the alternating-current system feeding the converter as far as the transformers, which, of course, in most cases, are located near at hand. In one test the noise from a synchronous converter has been picked up from the a.c. feeder almost uniformly for nine miles from the machine, but only in the vicinity of the circuit. It was not perceptible at a distance of more than 150 ft. from the circuit with a 6-tube super-heterodyne.

Direct-current motors, especially on street cars, are bad offenders for two reasons: first, because of the continuous operation of the contactor and probable sparking of the commutator; and, second, because of the direct connection with the low-resistance antenna system in the form of trolley and parallel feeders with no transformer winding to limit the distribution.

I recently was listening in 100 ft. away from the trolley, during the passing of a street car, and each opening of the circuit was plainly audible. Other sources of trouble on street cars are the arcing at the trolley and wheels and arcing grounds on the feeder. Insertion of chokes here and there in the feeder and laterals to trolley and also condenser drains to ground may do some good, but are expensive and afford only slight returns.

Interference Traceable to Industrial Sources.

(1) *Arc Light Circuits:* A good illustration of the extremes to which the public went with its complaints in the early days of broadcasting was the attempts of the citizens of a certain town in Texas to enact an ordinance to prevent the installation by the public utility of a street arc-lighting system.

From what has been said of arcs it might appear that such a system would be the worst offender possible. On the contrary, when in proper operation the modern arc-lighting system, including the constant-current transformers and rectifiers, should cause no trouble whatsoever. As is well known, the operation of the modern arc does not require the opening of the circuit. When the voltage across the arc rises to a certain value due to its natural elongation from the combustion of the carbon, the shunt magnet is energized sufficiently to pull the electrodes together, after which one drops until caught by the clutch. During this process, therefore, there is no opening of the circuit. The worst condition arising in an arc-light circuit is lamp-jumping. Then, of course, considerable energy is, released by radiation. There is little possibility of this if the globes and connections are taken care of carefully.

Under normal operation there should be no interference from the rectifier. If, however, the vacuum increases, due to the combining of the remnant of oxygen with the mercury, a condition prevails called "fading", which may result in the generation of high frequencies which are sent out over the lamp circuit. When the condition becomes still worse, so-called "pumping" of the

rectifier sets, serious interference results.

This difficulty is detected by noting whether or not a periodic decrease in load current is accompanied by a decrease in secondary voltage. If it is determined that the tubes are fading, the best thing is to notify the manufacturers, most of whom are prepared to assist in eliminating the trouble. Temporary relief may be obtained by the use of condensers and heating the tube in a steam bath or even letting it rest.

(2) *Smoke and Dust Precipitators* are inherently the source of a great deal of trouble, but the interference can be kept quite local by proper shielding and use of drains. No doubt most of you are acquainted with the Cottrell system of precipitation, but for those who are not it may be explained that the precipitation depends upon the application of a high direct voltage between the walls of a long tube through which the dust is passed, and a wire fixed in the center of the tube. This electrostatic field causes the movement of the dust particles to the tube walls. The voltage is obtained either through the use of Kenetrons or with mechanical rectifiers driven by synchronous motors. As there is no physical contact between the brushes and the commutator in the latter type, the continuous arcing is an excellent source of high-frequency oscillations, but as the transformers are very close to the rectifiers the only real source of radiation is the lead to the precipitation plates. This lead, therefore, should be very short and should be shielded. If the plates are in a steel stack they will need no other shielding. If not they also should be shielded and the shield grounded. Under these conditions the only thing noticeable will be the periodic flash-overs between precipitator plates, i.e., the tubes and wire.

(3) *Sign Flashers:* These are the worst offenders as far as arcing is concerned. Although there always will be some local interference—a matter of a few hundreds of feet—the situation in general can be remedied by the use of chokes and condensers. Being low-voltage equipment, the condenser drains are not expensive. If no preventive equipment is installed, any leads not in conduit become radiative antennas as far as the transformer.

Interference due to Household Appliances.

(1) *Heating Pads:* Although the manufacturers are improving the types and construction to get rid of interference-producing characteristics, these pads have been among the most noticeable offenders because of the several thermostats connected with them. If a pad is lying out in the open where it heats and cools rapidly, the thermostatic control opens and closes very definitely and distinctly, although fairly often. This causes but a click in the receiver. When the pad is in a semi-warm position, such as next the body, the change in temperature is comparatively slow with the result that as the control depends upon the unequal expansion of two metals the contacts may remain just out of contact but with a gap insufficient

to break the arc. The arc thus hangs on, producing a roaring sound in the receiver, not only in the house where the pad is, but in all receivers near the distribution lines that side of the transformer. In fact, the frequency is so low that considerable energy may pass through the first transformer, but usually there is not sufficient energy to saturate any other house circuit through a second transformer.

(2) *Violet-Ray Machines:* In the usual violet-ray equipment there are two radiating circuits, one including the primary of the high-tension, high-frequency transformer and the condenser; the other the secondary and the body through the tube. The local disturbance is slight except when the tube is raised from the body which does not happen often because of the more or less painful spark resulting from so doing. The disturbance sent out on the supply circuit may be removed completely by placing across the supply terminals (two) one-microfarad condensers in series and grounding the midpoint. In a test a violet-ray equipment was detected on a six-tube heterodyne at a distance of one block, and when drained as above noted the noise was not detectable when receiver was placed close to the machine.

(3) Other types of equipment of course may be the source of arcs due to defective circuits, etc., but they are of minor consequence and will not be considered here.

Miscellaneous Sources of of Interference.

There are a few pieces of equipment under this heading which may be mentioned. The utilities in nowise can be held accountable for the troubles arising in connection with them, however.

(1) *X-Ray Machines:* Complete data have not been taken on this type of equipment but most indications are that when properly operated and connected the modern X-ray machine should not give serious trouble. This is contrary to the popular belief.

(2) *Mechanical Rectifiers* in battery-charging equipment, on account of the continuous arcs formed at the vibrating contacts and to some extent the tube rectifiers, cause trouble which may be eliminated by the use of proper filters. Electrolytic rectifiers are not used enough to be noticed.

(3) *Electric Elevators:* There are two types of noises which arise from these: the clicks due to the making and breaking of the circuit by the contactors and the steady hum due to the operation of the motor, which, if it is d.c. and the commutation becomes bad, develops into a roar. With normal operation, the disturbances should not cover more territory than the building in which it is located. With poor contacting and poor commutation the disturbance may spread to great distances. Complete investigations of this have not yet been made, however.

(4) *Electric Furnaces* are a source of much local disturbance; especially during the first or melting period, but fortunately such a furnace is always operated through step-down transformers located as close to it as possible. The result is that the

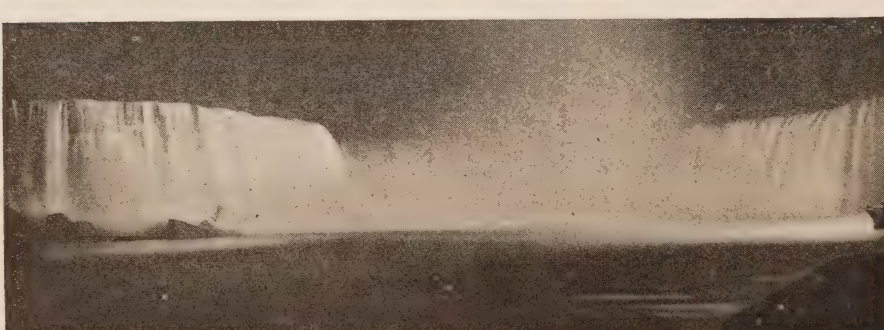
energy does not get out to produce interference. During a test a receiver placed 30 ft. below the high line one mile from the furnace during the melting-down period picked up nothing.

If it is admitted that steps must be taken to eliminate interference first, from the standpoint of self-preservation as obtained through the good will of the public, and, second, because of increasing revenue gained from the encouragement of the use of radio—how far are the power companies justified in going? Some of the larger utilities already have established separate departments with highly paid men to take care of the continuous stream of complaints and to eliminate not only the causes of those but also incipient sources of trouble not yet reported.

It would appear that, for the small and medium-sized company, such a step is too drastic under present conditions because of the expense involved. Definite arrangements should be made, however, with the trouble department for handling such cases as are reported. In doing this there are two things which will be found of value—establishing cordial relations and a feeling of co-operation with the local radio club or branch of the Radio Relay League, and the establishing of a system of questionnaires which may be sent to a consumer upon receipt of a complaint. These questionnaires can be so worded that they will eliminate many trips, thus saving considerable expense and at the same time assuring the consumer that the company is anxious to co-operate with him. Of course this method will lose its effectiveness if it is not followed up with personal attention as soon as the consumer again complains. In any case there should be no discussion or attempt to evade responsibility when there is any reason to believe that the trouble may be caused by the utility company's equipment.

For the good of the utilities themselves it is wisest to meet the question of radio interference fairly and squarely and to allow for it in the budget. In the long run they will be well repaid.

—*Journal of Electricity*.



List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in July, 1926.

Appliances

BLACK & DECKER MFG. CO., (Mfr.), Towson, Md.

THE BLACK & DECKER MFG. CO., (Submittor), 392 St. James St., Montreal, Que.

"B. & D.", Portable Electric Drills and Bench Grinders.

Portable Motor-driven Air Compressors. "Black & Decker."

* * * *

THE FITZGERALD MANUFACTURING COMPANY, Torrington, Conn.

"Star-Rite" Upright Toaster.

* * * *

THE HOOVER COMPANY LIMITED, Hamilton, Ont.

"Hoover," portable Vacuum Cleaner, Model 700.

* * * *

SPECIALTY LIGHTING CO., 200 Adelaide St. W., Toronto.

Floodlights and Spotlights, Nos. 1000F, 1000HF, 200F, 1000P, 400P, 250P.

* * * *

*NESTLE CO., C., 12-14 East 49th St., New York, N.Y.

Permanent Hair Waving Machines.

For permanent installation on ceiling, Types CLO, CLW, CLP, CNW, CNP.

Portable type, Types PL, PN, "WHEELABOUT," WL, WLO, WN.

Marking: Manufacturer's name on nameplate.

*MEYER CO., THE WM. (Mfr.) 1644-48 Girard St., Chicago, Ill.

JONES BROS. & CO. LIMITED (Submittor), Adelaide St. West, Toronto.

Marcelling iron heaters, Cat. No. G535.

Hair Dryers, Cat. No. G-421-2.

Marking: Nameplate and rating.

* * * *

DOWSWELL LEES & CO., (Mfr.), Hamilton, Ont.

THE ROBT. SIMPSON CO. LIMITED, (Submittor), Toronto, Ont.

Washing Machine, "Simpson Special".

* * * *

Portable Lighting Devices

WALSH ELECTRICAL CO. LIMITED, 465 Church St., Toronto, Ont.

Portable electric lamps.

* * * *

Switches

*PENN ELECTRIC MACHINE CO., Des Moines, Iowa.

Automatic Switch—Float Type, Type DF.

* * * *

*TAYLOR ELECTRIC MFG. CO. LTD., 526 Adelaide St., London, Ont.

Panelboards, "F.A.Safety". Types TP, TPD, NTP, NTPD, TC, TCD, NTC, NTCD, R, NR, R3G, NR3G, 2P, N2P.

Marking: Nameplate with rating.

*Westinghouse Electric & Mfg. Co., Brooklyn Works, Brooklyn, N.Y.

Enclosed Switches (as listed on Underwriters' Laboratories card dated February 18, 1926).

* * * *

*Westinghouse Electric & Mfg. Co., Mansfield Works, Mansfield, Ohio.

Enclosed Switches (As listed on Underwriters' Laboratories cards dated January 8, 1926, February 12, February 20, 1926, May 14, 1926).

* * * *

*Westinghouse Electric & Mfg. Co., (Submittor), East Pittsburgh, Pa.

Enclosed Switches (As listed on Underwriters' Laboratories cards dated July 10, 1925, February 17, 1926, April 3, 1925).

* * * *

Westinghouse Electric Products Co., (Mfr.), Mansfield, Ohio.

*Westinghouse Electric & Mfg. Co., (Submittor), East Pittsburgh, Pa.

Enclosed Switches (As listed on Underwriters' Laboratories cards dated May 16, 1924 and June 17, 1924).

Fittings

Paiste Co., H. T. (Mfr.), 3201 Arch St., Philadelphia, Pa.

*Hart & Hegeman Mfg. Co., (Submittor), 342 Capitol Ave., Hartford, Conn.

Medium Base Sockets, 660 W., 250 V. (As listed on Underwriters' Laboratories card dated June 1, 1926).

* * * *

Messervey's Industries Inc., 257 Washington St., Buffalo, N.Y.

Two-way current taps, porcelain, Cat. No. 110.

Marking: "M" enclosed in diamond on porcelain, "Messervey's BUFFALO" stamped in metal of centre contact.

* * * *

Miscellaneous

The T. Eaton Company Limited, Toronto, Ont.

Cord Set.

Marking: Tag attached to each device with manufacturer's name and address.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

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Electric Drive in the Pulp and Paper Industry

By T. C. James, Assistant Engineer, H.E.P.C of Ont.

THE art of paper making is perhaps one of the oldest of all industries associated with the human race, although there is a vast difference between the efforts of the ancient Persians 10,000 years B.C. utilizing the rocks and cliffs for preserving their thoughts and records, or from the stone slabs, bronze and ivory plates of latter periods, to the modern pulp and paper mills.

The evolution of paper making forms a most interesting study when traced down through the various ages to the present day, and as one follows step by step from the beeswaxed board of the ancient Egyptians, the wood tablets and the tile and clay tablets of the Assyrians and Chaldeans 4,000 B.C. it is found that the art gradually assumed a tendency toward the use of thinner substances such as parchment made from the skins of animals and the papyrus parchment of the Egyptians in use 2,000 B.C.

The art of making paper from vegetable substance reduced to fibre, which forms the basis of modern practice, is ascribed to the Chinese in A.D. 102, and up to the end of the 18th century paper making was largely a hand process, the first paper making machine being invented in 1798.

The practical introduction of mechanical wood pulp was not accomplished until 1840, and the present sulphite process perfected and satisfactorily utilized until 1874. Mechanical and chemical wood pulp are, therefore, practically modern in their application to paper making, rags and other substances of vegetable origin being almost exclusively

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September, 1926

used up to the advent of wood pulp.

It will be noted, therefore, that wood pulp became a factor in paper production just prior to the time when the advantages of electrical energy were beginning to be realized; first for lighting purposes, and later for power for industrial purposes, and there is no doubt whatever but that the electric drive has played a most important part in the development of the pulp and paper industry to its present day status, and it is equally true that only by means of electric drive could the present overall efficiency be obtained in the pulp and paper industry, or the tremendous production and output of modern mills be accomplished. This fact is quite manifest by the adapting of electric drive to paper making machines, the last piece of apparatus in modern paper mills to succumb to electric drive, as by means of such, not only is it possible to increase the speed of the paper through the machine, but rolls of much greater width are also possible, thus increasing both efficiency and production.

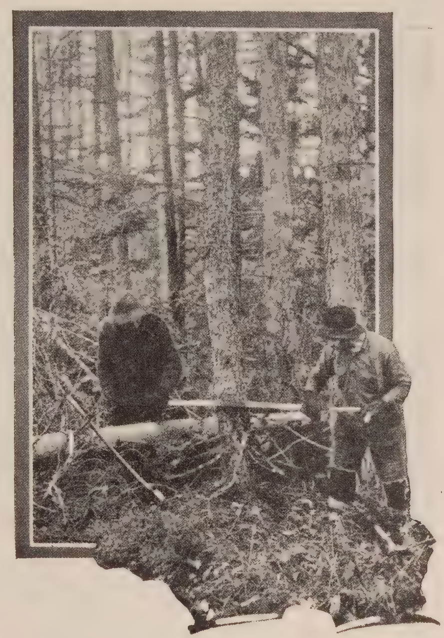
The principal woods used in the production of both chemical and mechanical or ground wood pulp are spruce, balsam and hemlock, spruce being the most suitable and the most extensively used; consequently, the large modern pulp and paper mills are located in close proximity to the heavily wooded sections of the country where the growth of such types of timber predominate, such as New Brunswick, Quebec, Northern Ontario, parts of Manitoba and British Columbia. As very large blocks of power are also required in the successful manufacture of pulp and paper, these mills are always located at or near the source of some large water power, thus the raw material and cheap power are the two most essential features of successful pulp and paper manufacture. Nature seems to have provided in Canada an abundance of both of these commodities side by side, as many of the greatest water power sources are located in the heart of the timber country, which naturally accounts for the enormous progress made in this branch of Canadian industry during the past 25 years.

All large mills operate their own timber limits, usually under a Crown lease from the Provincial Government of the particular province in which the limits are located, but

large quantities of pulp wood are also obtained from settlers who cut the timber from their own private lands, and in many sections pulp wood forms the bulk of the settlers' crops.

The first operation through which the log passes is in the cut-up mill, usually consisting of a log haul-up for removing logs from the pond, a slasher which consists of a number of circular saws to cut the logs to a number of predetermined lengths against which the logs are carried on an inclined plain by endless chains, a conveyer to carry cut logs to any desired location and to dispose of all waste, all of which operations require the application of power, thus affording ample opportunity for utilizing the niceties of electric drive, as by means of individual motors the proper and most efficient grouping of apparatus is accomplished, as well as making possible the utilizing of the most suitable location for the equipment.

The next process to which the wood is subjected after leaving the cut-up mill is that of barking, which, as the name implies, involves the removal of all bark from the log surface. This is accomplished in some instances by a pressure against a series of revolving knives, but more generally in a huge tumbling machine or revolving drum, with the log passing in at one end and gradually working out at the other, the entire process being subjected to a constant stream of water to remove all waste and to facilitate the operation. After barking, the wood is then ready for the grinder



Felling timber for pulp wood.

where mechanical pulp is to be made, or the chippers for chemical pulp, and the logs pass on to the wood room where such work is performed, this wood room being one of the most important parts of a modern mill. After leaving the slasher or barker and before going to the wood room, most of the logs are delivered to a stock pile, as both the cut-up mill and the barker are capable of handling pulp wood faster than the grinding and chipping rooms, thus a constant supply of wood is assured for production purposes at all times regardless of any fluctuation in the process of cutting the timber and the delivery of same to the mill, which latter operations are largely carried on during the winter, as far as cutting the timber is concerned, and during the spring and

Barking machines in wood room.

summer, as far as delivery is concerned.

Mechanical pulp is produced by grinding the log, causing a mechanical abrasion of the small wood fibres that go to make up the pulpwood structure. This is accomplished by pressing the log against a revolving grindstone. Pressure is obtained by a hydraulic press and water is used to cool the stone and to wash out the fibres from the grooves in its surface.

The most familiar grinder is the three-pocket type which will produce from 5 to 7 tons of pulp per day and requires from 300 to 500 h.p. to operate. This type is generally driven by hydraulic turbines at a speed of from 200 to 260 revolutions per minute, although electric motors may also be used where it is more desirable to do so and circumstances warrant. A better type of grinder is the four-pocket unit which enables grinding to be carried on constantly at three pockets with a fourth always available for being filled with wood.

In the large mills magazine grinders are generally used which gives a unit of greater capacity with less attendance, thus increasing both efficiency and production, with a resultant reduction in cost of output. This type will produce from 16 to 25 tons of pulp per twenty-four hours and effects a saving of about 55 per cent. in the man-hours attendance required per 100 tons of output. Magazine grinders are usually driven in pairs by synchronous motors of from 2400 to 2800 h.p. capacity and operate at from 215 to 240 revolutions per minute.

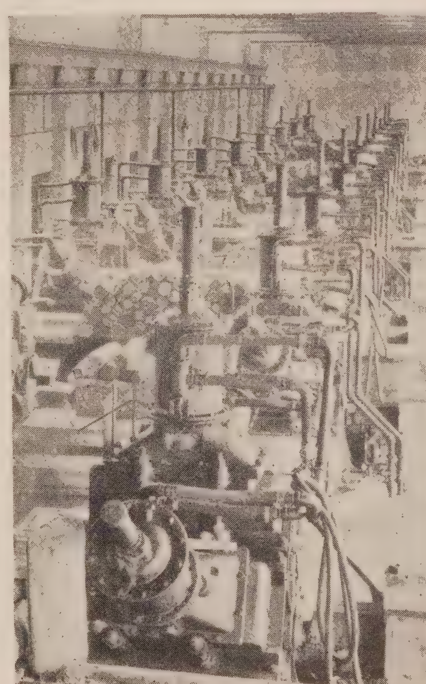
The pulp, after grinding, is deposited into what is known as the stock sewer, at which point water is added for sluicing or thinning, and the mixture is then passed through a

process of screening to remove the coarser material and eventually reaches the screen stock pit, from which it is removed by means of a centrifugal pump to a set of finer screens to further remove the remaining coarser fibres. The stock, after passing through the finer screen plates, is then suitable for making paper and is deposited into a distributing box and then concentrated for storage, or commercial shipment, in what is known as a wet machine.

The screening system is always located at an elevation above the grinding room so that the water removed from the pulp in the concentrating process may be easily returned for use in the grinding showers and for mixture with the pulp in the stock sewers. Briefly, the whole process may be summarized as grinding up the log on a grindstone, thinning out the stock with water, screening out all coarse fibres and concentrating the stock for storage or shipment.

As centrifugal pumps are utilized in handling the water in the grinding process, and the wet stock after leaving the grinders, electric drive greatly facilitates economical operation by means of motor driven pumps at the most suitable locations. These motor driven pumps vary in size from 15 to 40 h.p. for the water system, and from 25 to 75 h.p. in handling the stock. These motors are almost invariably of the squirrel cage type, except those used on the grinders, which are synchronous motors. All motors used in pulp mills require very careful construction and installation as they are subjected to as severe moisture conditions as will be found in any industrial or manufacturing process.

In the production of chemical pulp it is first necessary to reduce the pulp logs to chips, which is accomplished in a machine called a chipper. The chipper in general use takes the log end-on, the lower end coming in contact with a revolving chipper disc equipped with heavy knives, the log thus being sliced into chips varying in size from ½ to 1 inch in length and from ⅛ to 3/16 inches in thickness, which drop into a pit below the machine. The chipper discs vary in diameter from 47 to 88 inches, revolving at from 275 to 600 rev.

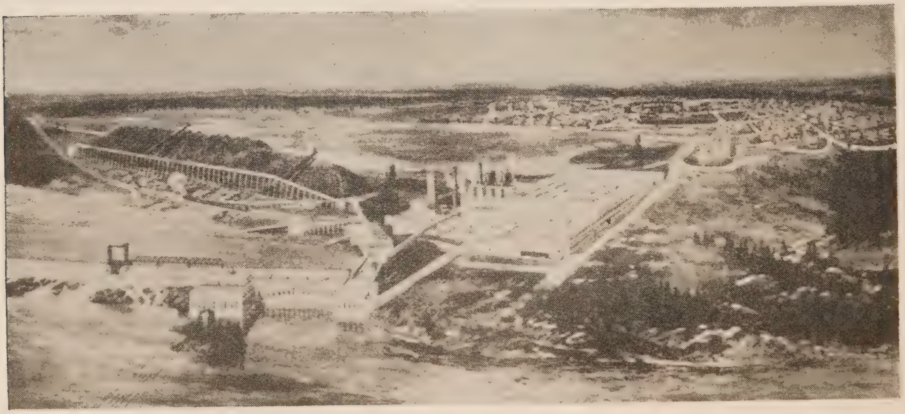


Battery of three pocket grinders in grinder room.

per min. and require motors varying in size from 50 to 100 h.p. to operate, the total output of these machines ranging from 4½ to 12½ cords per hour. The chips, after being screened, pass on by conveyor to chip bins located above the digesters. Large chips which do not pass through the chip screens are broken up in chip crushers, or rechippers, operated by motors varying in size from 10 to 30 h.p.

Chemical pulp is produced by a treatment which brings the non-cellulose materials in the wood into solution, thus leaving the cellulose fibre, which makes up about 50 per cent. of the wood, free for a commercial product. Chemical pulp manufactured from wood generally consists of three types—sulphite, which is an acid product, utilizing the same types of wood as in the mechanical or groundwood process; soda pulp, utilizing such woods as poplar, white maple, birch, chestnut and basswood; also sulphate, which is a modification of the soda process used almost exclusively with coniferous woods.

Chemical pulp is produced in what is known as a digester. This digester consists of a closed steel tank or shell made up of specially riveted or welded steel plates of about 1⅛ in. in thickness and protected on the inside by an acid resisting brick lining. The chips are fed into the digester by gravity from the chip bins and in the sulphite process the acid is pumped in by a pipe line either at the top or bottom of the tank. When the digester is full of chips and acid, live steam, which may be either saturated or superheated, is admitted and the mixture is gradually brought to the desired temperature and pressure. A cooking process is thus carried on until a pulp of the desired grade is obtained, determined by tests made at various times during the cooking operation, which generally requires from eight to fourteen hours to complete, after which the digester is "blown", the charge



Panoramic view of the Abitibi Pulp and Paper mill at Iroquois Falls, Ont. showing power plant in the foreground and block pile in the rear.

being deposited in a compartment beneath. From this point the operation in the treatment of the pulp thus obtained is similar to that of the groundwood pulp, the product being cleaned, screened and concentrated for storage or shipment.

The bisulphite liquor used for making sulphite pulp is produced by,—

(1) The burning of sulphur or pyrites.

(2) The absorption of the resulting sulphur dioxide gas in a milk of lime solution or in water in the presence of limestone.

(3) The strengthening of the acid with sulphur dioxide recovered from the cooking process.

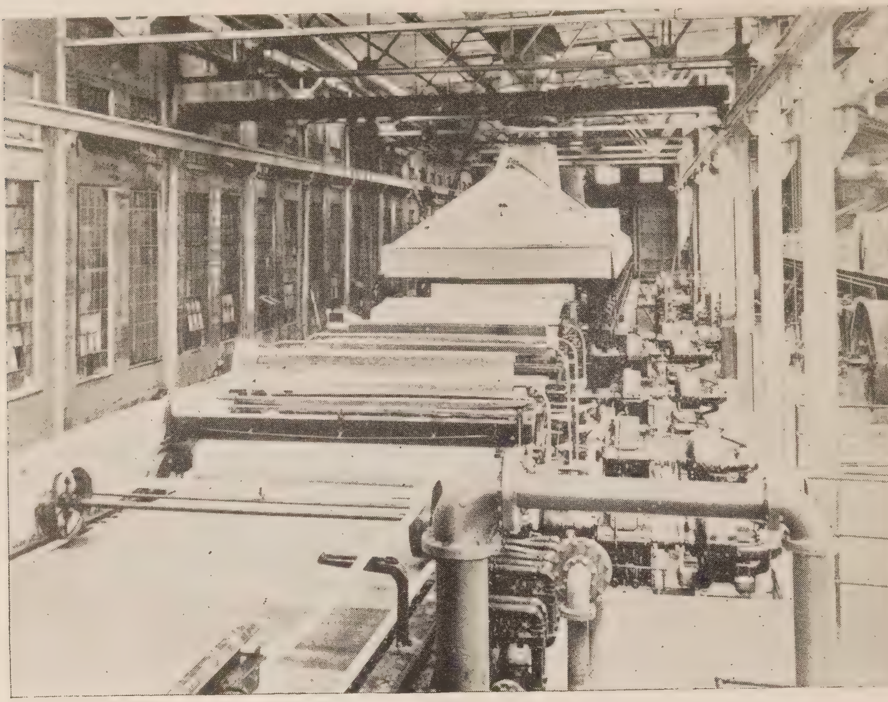
The process of making pulp by the use of a caustic soda solution producing what is known as soda pulp, is one of the oldest chemical methods in use. Owing to the shortness of the fibres this kind does not make a strong paper, but is satisfactorily employed for the softer grades and is capable of producing a good finished surface.

Sulphate pulp is produced by treating the wood chips with a solution, the active components of which are sodium hydrates and sodium sulphide.

Other materials used for making pulp are as follows: Cotton, Linen, Jute, Straw, Manilla, China Grass, Bamboo, Sugar Cane, and Paper Mulberry.

Various grades of pulp are used for making different types of paper and groundwood or mechanical pulp mixed with sulphite or chemical pulp is utilized in the manufacture of newsprint. Groundwood and chemical pulp are also used for the cheaper grades of book paper, wall paper, and the like. For high grade linen paper and similar stock, the pulp made from rags, and other vegetable substances are generally used, as the wood pulp is not suitable for such product. The making of paper of all kinds and varieties consists of the blending of various kinds of pulp, according to the composition of the fibres, in order to obtain the grade of paper desired. Generally speaking, the pulp and paper industry in Canada is largely associated with the manufacture of mechanical and chemical wood pulp which are utilized for making most of the papers in use at the present time.

The paper machine itself is a very complicated piece of apparatus requiring very careful construction and must be operated at constant speed with very close regulation. Up to 1905 the drive for paper machines was accomplished almost exclusively by steam equipment and electric drive has only been utilized since that date. From 1905 to 1910 several installations of electrical sectional paper machine drives were utilized, but without automatic speed regulation, in an effort to eliminate the short comings of mechanical drive. Almost all of such types, however, were unsuccessful and it was only through a great deal of effort and care in the operation of such equipment that these electric driven machines were continued in operation. In recent years, however, electric drive has been very satisfactorily accomplished by means of



Wet end of a paper machine showing sectional electrical drive throughout.

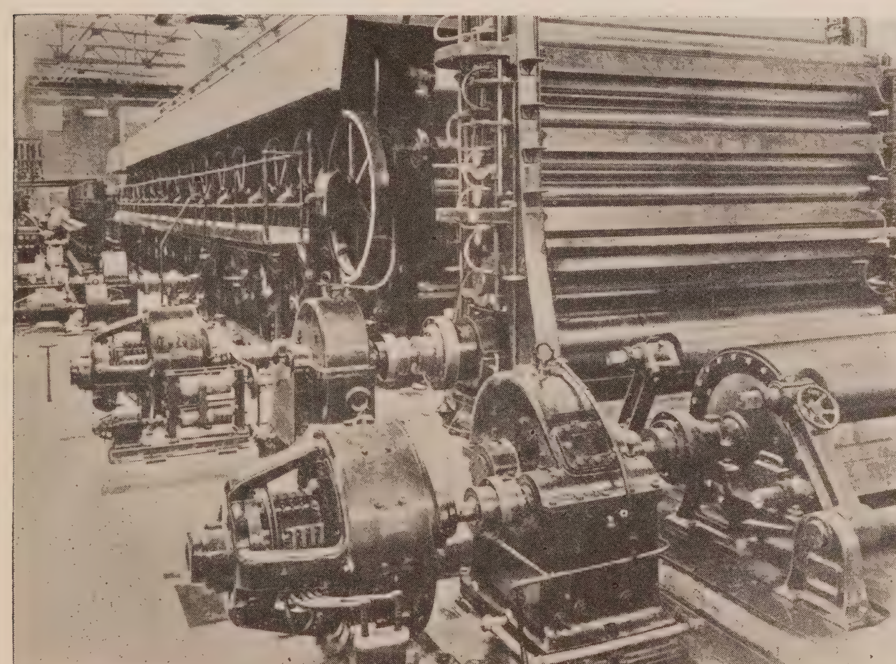
the utilization of automatically controlled equipment.

The making of paper in the paper machine is accomplished by reducing the stock mixture, evenly distributing the fibres in proper relation, fabricating them into a continuous web, removing excess water by filtration, pressure and heat, giving the final sheet its desired finish, and winding it into rolls of suitable size for shipment.

There are two types of paper machines in general use, the "Fourdriner" for making newsprint, craft, book, writing and high grade papers, and the "Cylinder" machines for making box paper, container board and the heavier sheet types, the difference being in the wet or forming end of the machine. The stock reaches the paper machine in a fluid mass about ½ to 1 per cent. stock and 99 to 99½ per cent. water. The first section of a paper machine is known as the "Couch" on which the sheet is formed. In this process the liquid stock flows by gravity on to a revolving screen from a thin submerged orifice extending over the entire width of the machine and located just above the screen. As the stock flows over this screen the greater portion of the water passes through by gravity, a considerable portion of the remaining water being removed later on by being drawn through the wire from the stock film on its surface, by a number of flat suction boxes located

below it, in which ten to 15 inches of vacuum is maintained. This process of forming the sheet and removing 99 per cent. of the water is accomplished in about three seconds. The sheet leaves the Couch very wet and frail and passes on to a series of presses, each press consisting of a felt mat revolving over a series of rolls. From the presses the sheet travels over a series of revolving drums steam heated, called driers, during which process practically all of the remaining moisture is removed. After drying, the sheet passes over a span of about 5 feet to the callander stack comprising a number of polished steel rolls, for the purpose of obtaining a finished surface on the paper, which is then wound on rolls and cut to the desired width for commercial use.

News print paper machines in use at the present time produce paper in rolls approximately 18 to 20 ft. in width, although machines are now under construction which will produce a roll 25 ft. in width. The length of a sheet of paper in the process of manufacture in a paper machine is about 170 ft., and with electrical sectional drive and automatic control, speeds up to 1,200 ft. per minute through the machine are possible. In fact, the improvements perfected in electrically driven paper machines have made possible greater width of rolls, as well as greater speeds in passing the paper through the machines, which natur-



Paper machine from callander end showing features of sectional electric drive.

ally secures greater production at increased efficiency.

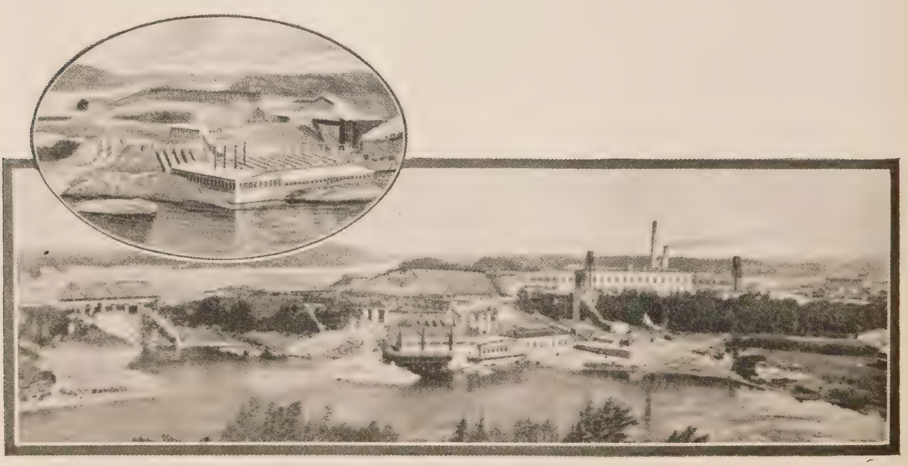
The entire time taken to pass the sheet through a paper machine from Couch to Rerolls is about 40 seconds and in news print machines paper is made in continuous sheets varying in length from 250 to 10,000 miles.

Generally speaking, the speeds of paper machines vary from 600 to 1,200 ft. per minute for news print, 200 to 800 ft. per minute for craft paper, and 100 to 600 ft. per minute for book paper.

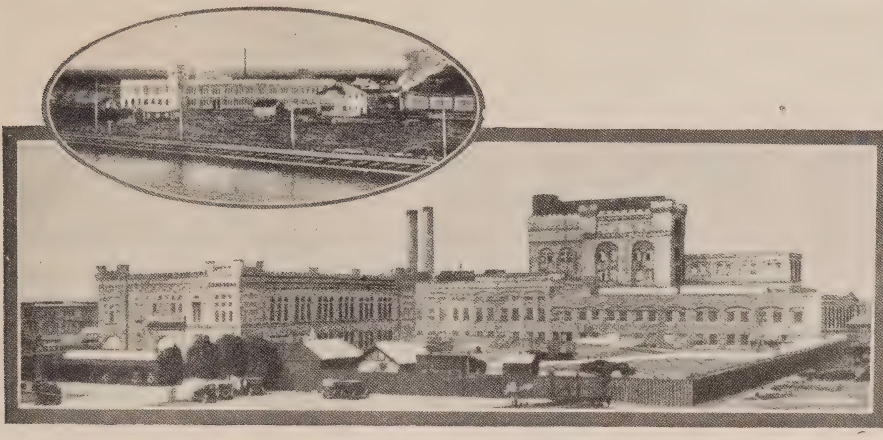
Cylinder machines making the coarser grades of paper operate at slower speeds varying from 35 to 350 ft. per minute.

It is impossible within the scope of this paper to fully describe the details of the automatic control sectional electric drive now in general use on paper machines, but a brief description will no doubt convey to the reader the most essential features. If more information is desired same can be obtained by referring to the 1926 March, April and May transactions of the American Institute of Electrical Engineers in which appear three papers read at the Regional Convention held at Cleveland on March 18th and 19th of this year by Mr. Steven A. Staege of the Westinghouse Electric & Mfg. Co., Pittsburg; Mr. H. W. Rogers of The General Electric Co., Schenectady; and Mr. R. N. Norris of The Harland Engineering Co. of Canada, Montreal; all authorities on this subject.

A motor generator set or turbo-generator set of about 200 to 600 kw. capacity is employed as the original power source, the generator being direct current separately excited, shunt wound and equipped with a voltage regulator for both generator and exciter. Adjustable speed d.c. motors are used for each section of the machine, one for the Couch, one for each of the presses, which in most machines are in four



The Espanola Pulp Mill of the Spanish River Pulp and Paper Co., Limited (original plant in the oval).



The Sault Ste. Marie Mill of the Spanish River Pulp and Paper Co., Limited, (original plant in the oval).

sections, two for the drivers and one for the callander. These motors vary in capacity according to the size of the machines and range from 35 to 200 h.p.

The speed control of the various sectional motors is accomplished by utilizing what is known as the "Ward Leonard" system, each sectional motor being tied in solid with the armature of the d.c. generator, variable speed for the motors being obtained by varying the generator voltage, while push buttons located at convenient points on the paper machine itself provide for a very satisfactory method of remote control. Each sectional motor is equipped with an individual regulating device which may be adjusted for any desired draw, thus making possible the maintenance of the proper relative speed of each sectional drive, a most essential necessity in paper machine operation.

Two different types of drive are utilized for the individual sectional motor regulator equipment by the various manufacturers furnishing same, one being "electrical" and the other "mechanical". With the electrical drive a small a.c. master generator is used driven by a small d.c. motor, or from the drier section motor. This a.c. generator drives a small a.c. synchronous motor at each sectional motor. The a.c. synchronous motor is connected to a cone pulley through the sectional field resistance regulator. The cone pulley is operated from the sectional motor and any variation in speed of the latter will react through the cone pulley on a device driven by the a.c. synchronous motor in such a manner as to operate the arm of the field resistance regulator cutting "in" or "out" shunt field resistance, which enables the maintenance of a constant uniform speed under all conditions.

The mechanical drive employed consists of a master line shaft extending from end to end of the entire paper machine and operated by either a small individual motor or

by the drier section motor. At each sectional drive a shaft operated by a worm gear from the master shaft, but at right angles to same, extends to the regulator equipment at the sectional motor. A cone pulley operated by the section motor is so connected to the field resistance regulator and the master shaft through a set of differential gears that with the master shaft operating at a fixed speed and the cone pulley shaft operated from the sectional motor, and both turning in opposite directions, any variation in speed of the sectional motor will immediately react on the gear driving the regulator arm so as to cut "in" or "out" field resistance in the sectional motor and thus maintain constant speed.

Both types of equipment accomplish the same results and are similar in principle. The method employed for accomplishing results, however, differ in the respect that one is "electrical" and the other "mechanical".

The method of starting up the electrical equipment of a sectional drive paper machine is as follows:

The turbo-generator, or the motor generator set is started and the generator voltage brought up to, say, 200 volts direct current. Each sectional motor is then started separately by pressing the proper push button control and the motor begins to turn slowly, due to armature resistance being applied. Another push button is pressed and magnetic contractors are closed in sequence, cutting out armature resistance until the motor is operating on full armature voltage, when the regulating equipment is then brought into operation.

In conclusion it might be interesting to note that the manufacture of pulp and paper in Canada has been rapidly increasing in the past few years and the extent of this increase in production is very interesting when compared with the output in the United States. In the year 1917 Canada produced 689,847 tons of news-print paper and the United States 1,359,012 tons. In the year 1925 the production of news-print paper in Canada amounted to 1,522,217 tons, and the output in the United States in the same year exceeded this amount by only 8,000 tons. In all probability 1926 and 1927 figures in Canada will show a production of news-print in excess of the United States output.

In 1917 the total output of pulp produced in Canada, inclusive of mechanical sulphite and sulphate, was 1,460,018, while in 1924 the total output was 2,423,024 tons.

The production in Canada of various grades of paper other than news-print is on a somewhat smaller scale. There are, however, considerable quantities of board, book, writing, wrapping, and other grades produced in greatly increasing quantities each year, and new mills and additions to existing mills are being constructed throughout the country from coast to coast. Perhaps the greatest activity in the next five years in the pulp and paper production will take place in the Thunder Bay District at Port Arthur and Fort William, which is rapidly becoming one of the pulp and paper

centres of Canada. It is gratifying to note that one of the principal reasons for increased production in this locality is due to the policy of the Hydro-Electric Power Commission in providing large quantities of cheap power at both Port Arthur and Fort William, and there is no doubt whatever but that the Hydro developments on the Nipigon river have been largely instrumental in making such conditions possible. At the present time there are five existing pulp and paper mills in this district and when their present construction program is completed in 1932 in accordance with the contracts recently executed with the Province, the daily output of the combined mills at Port Arthur and Fort William will be in the neighborhood of 1,600 to 1,700 tons.

Port Dover

By H. D. Rothwell, Assistant Engineer, H.E.P.C. of Ont.

Nous icy soubsignés certifions avoir vu afficher sur les terres du lac, nomme d'Erié, les armes du roy de France, au pied d'une croix avec cette inscription.

"L'an de salut 1669, Clément 9 étant assis dans la chaire de St. Pierre, Louis 14 régnant en France, Monsieur de Courcelles étant gouverneur de la Nouvelle-France et Monsieur Talon y étant Intendant pour le roy, sont arrivés en ce lieu deux missionaires du séminaire du Montreal accompagnés de 7 autres Francois qui les premiers de tous les peuples Européens ont hyverné en ce lac dont ils ont pris possession au nom de leur roy, comme d'une terre non occupée, par l'apposition de ses armes qu'ils ont attachées au pied de cette croix."

En joy de quoy avons signé le présent certificat.

Francois Dollier, prestre du diocèse de Nantes, en Bretagne

De Galinée, diacre du diocèse de Rennes, en Bretagne.

THE first view the white race had of the country where the Town of Port Dover now stands was in the year 1669 when two Jesuit priests, Francois Dollier and De Galinee, accompanied by several other Frenchmen, wintered on the Black Creek a mile or so from the Lake Erie shore line and a short distance from the present Town limits. To the memory of these intrepid explorers there has been erected, on a high hill overlooking the Lake and the Harbor of Port Dover, a monument bearing the above inscription to commemorate the discovery of the spot where the beautiful Town of Port Dover now stands.

The Town is unique in many respects for its diversified industrial attainment and not the least of these is its important fishing industry. This industry has developed during the past few years to a most remarkable extent and today it

Port Dover Harbor.

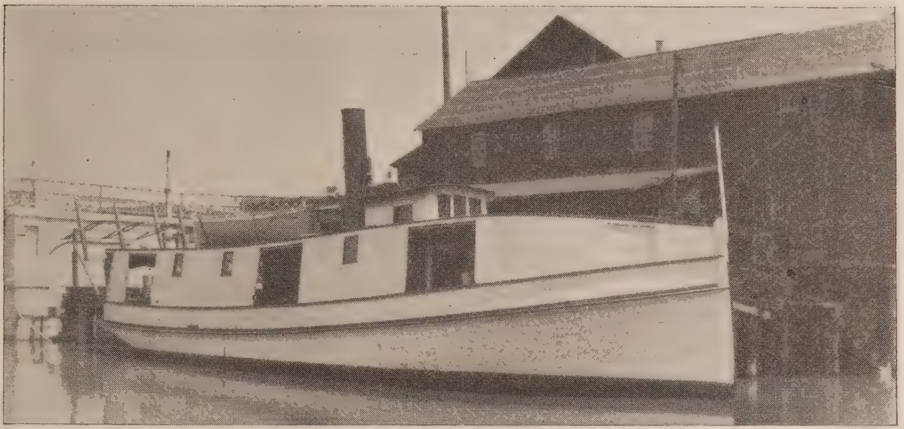
holds the premier position of being the most important fishing port in Canada situated on the Great Lakes.

In reviewing the report of the Department of Game and Fisheries for the Province of Ontario for the year 1924, the total fish caught in that year in the entire Province was 41,732,664 pounds, of which 18,977,289 pounds were caught in Lake Erie. By far the most important catch is Herring, which for Lake Erie in the same year totalled nearly 11,000,000 pounds and an excess of 50 percent of this was caught and brought into the Harbor of Port Dover.

The fishing industry in that port supports between 150 and 175 men, employed totally in this work and with their families and dependents it will thus be seen that at least 750 to 900 of the inhabitants of the Town are dependent upon this one industry.

With the creation of any industry

Part of Port Dover fishing fleet.



A tyical Lake Erie fishing tug, net houses and freezing plant of Norfolk Fish Company in the background.

many problems will arise which will require solution by modern scientific methods in order that the greatest return may be obtained for the labor expended. The fishing industry is no exception in this case. During the years 1923 and 1924 very large catch were made with the result that market conditions were seriously affected and a very low price was obtained on that account. If these fish could have been frozen and stored until market conditions would be more favorable a huge increase in profit would have resulted and an immense waste through spoilage would have been avoided.

The importance of artificial refrigeration for the freezing and storage of fish was recognized early in 1924 by the Norfolk Fish Co., of Port Dover, who installed a plant that year, which was followed by the Kolbe Fish Company in 1925; the former being a distinctly different system to the latter. In the case of the Norfolk Fish Company a direct freezing system is employed. The fish are laid in rows of large pans and placed directly on the cooling coils in the Freezing Chamber or "Sharp" room where they are frozen solid in a temperature well below zero Fahrenheit. During the process of freezing the fish are occasionally sprayed with water in order that a glaze of ice will be formed to prevent oxidation. After freezing they are removed to a large storage room to await a time when the market conditions are most favorable. The Kolbe Company system is somewhat different from that employed by the Norfolk Company. This Company places their fish in pans which in turn are stacked in a series of inverted pans resembling small diving bells, the whole being lowered directly into a brine tank which is maintained at a very low temperature and where they are allowed to remain until thoroughly frozen. Various claims are maintained as to the merits of both systems but the

net result is that there is no longer a time when the fishing operators are forced to dump their product on the market on account of their inability to properly take care of the catch.

The importance of this Municipality has been recognized for many years as a summer resort as well as for market gardening, canning, raising of poultry and last but not least the development of horticulture as practiced by private individuals and companies.

Ontario Hydro-Electric Club Picnic

Line up for the first event.

The Annual Picnic of the Ontario Hydro-Electric Club, at Queenston Heights on July 6th last, was the most successful event of its kind held since the inception of the Club. These annual picnics are the most widely supported functions of all the Club's activities.

Naturally a great deal of work is involved in looking after the various phases of such an outing. The most arduous of these is the serving of refreshments which was very ably and pleasingly done by members of the Municipal Department. The arrangement and execution of the Sports programme, also a big undertaking, was very efficiently handled by the Operating Department Transportation of baskets and supplies was in charge of the Construction Department and entertainment on the boat and at the park, especially for the kiddies, was an assured success when entrusted to such genial souls as Messrs. Cassidy and Hare. The enjoyment of the trip on the morning boat was much enhanced by music rendered by our own orchestra.

The officers of the Club wish to express their appreciation of the hearty support given by the officers and members of the Commission, the members of the club and staff, and to thank the members of the various committees who so ably co-operated in making this year's picnic such a grand success.

Application of Hydro-Electric Power to Farm Work

Article No. 3.

OUR article this time is on the installation of Hydro-Electric power for specially handling milk so as to meet the demand for a product suitable for invalids and babies.

About two years ago, Mr. Abraham Snider, whose farm is located close to Waterloo, put in practice an idea that he had in mind for a long time, that is, the supplying of a pure and wholesome milk to meet the demands of local market in Kitchener and Waterloo, the need of which had come to his attention through his contact with some of the doctors.

Service to this farm is 110/220 volt, 3 phase, at present supplied by the Town of Waterloo. The rate in this rural power district for class "6B" is: Service charge $7.50 per month, 4 cents per kilowatt hour for the first 126 kilowatt hours used in any month, and 2 cents for the balance, with standard prompt payment discount of 10 per cent.

The installation consists of:

Lighting all the premises, about	1,500	watts
Electric iron	600	"
Washing Machine	186	"
2—5 h.p. motors	7,460	"
1—1 " "	746	"
1—½ " "	373	"
2—¼ " "	373	"
1—1 k.w. heater	1,000	"
1—2 " "	2,000	"
1—3 " "	3,000	"
	1,7238	watts

The uses of electric power on the farm consist of:

In the barn a 5 h.p. motor is belted to a line shafting which provides the drive for a milking machine pump, a chopper and a root pulper.

In the dairy a ton refrigeration machine provides the means of cooling milk while aerating, as well as refrigeration for cooling-room for storage and quick cooling after pasteurization.

Fig. 1. Farm Buildings and Dairy Herd.

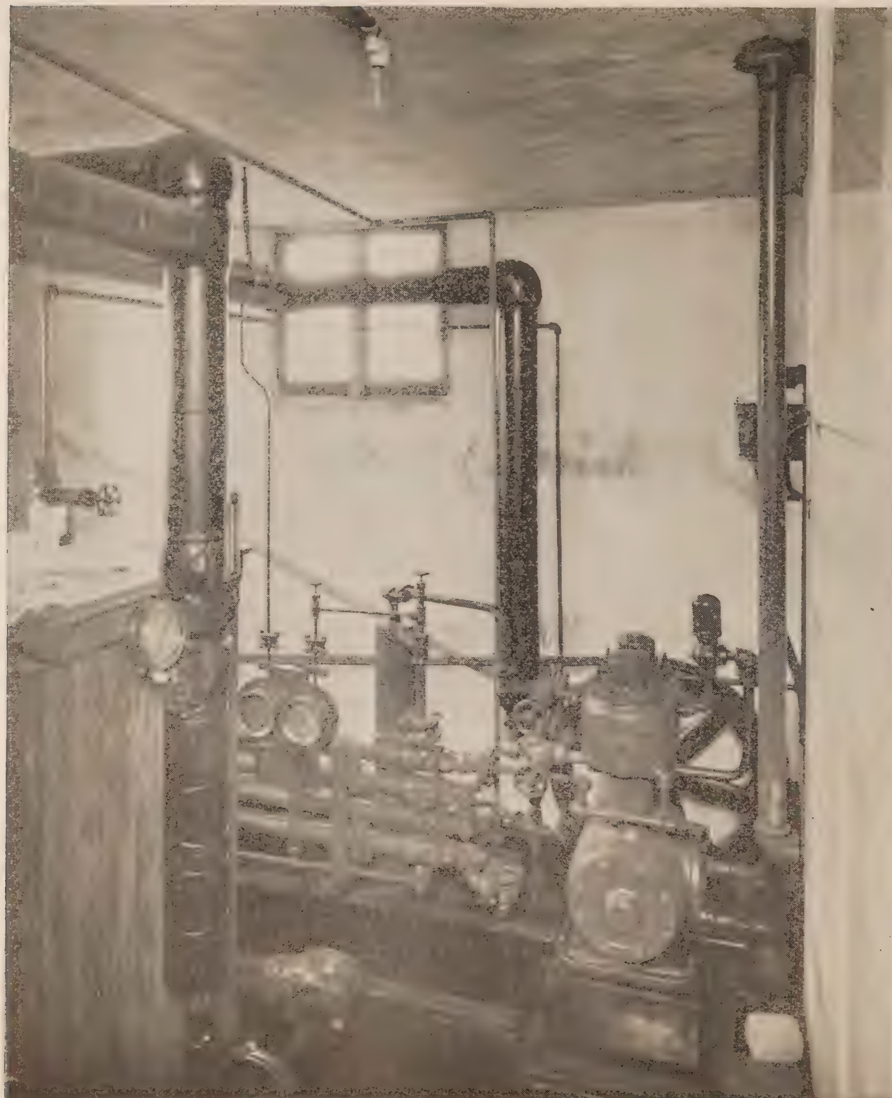


Fig. 2. Refrigeration Machine driven by a 5 h.p. motor. A 1 h.p. motor operates the brine pump and a ½ h.p. motor, the water pump.

The 1 h.p. motor on the brine pump maintains circulation so as to take advantage of circulating brine after the compressor has been shut down.

The ½ h.p. motor on the water pump provides the water supply for dairy, barn and house use.

The pasteurization tank shown in Fig. 5 has a stirring mechanism which is driven by a ¼ h.p. motor.

The bottle washing machine shown in Fig. 4 is also driven by a ¼ h.p. motor.

There are two hot water tanks, both of which are lagged, in which electric heaters of the bayonet type have been installed and the power is turned on for this purpose when not in use for other services on the farm.

The dairy herd usually consists of about twenty-five head of Holstein cattle. The herd is shown in Fig. 1 with the ensemble of buildings.

Below is given, in detail, the power consumption, by months, assigned to the different classes of service:

Total consumption 13,460 kw-hr.

Mr. Snider is a member of one of the three syndicates in the Waterloo district that are using a 20 h.p. motor for silo filling and threshing purposes. It is to be noted that the amount of power used for this purpose on this farm is small, amounting to only 448 kilowatt-hours. The amount used for lighting and domestic service is 946 kilowatt-hours. The small power uses include refrigeration and probably the greater portion of the 2,974 kilowatt-hours are used in the dairy. The power used for the heating of water, from August 1st to December 31st, is recorded separately and amounts to 9,540 kilowatt-hours. The total uses on the place 13,460 kilowatt-hours.

The heating of water by this method, while convenient, clean and highly desirable, may not be the most economical way of doing it. It would seem that a hot water

CONSUMPTION IN KILOWATT-HOURS.

Month.	Domestic	Small Power	Threshing and Silo-Filling
January	93	70	183
February	119	70	
March	90	200	
April	70	220	
May	65	90	21
June	48	160	
July	53	440	
August	46	170	
September	41	440	59
October	86	494	
November	125	330	185
December	110	290	
	946	2,974	448

For heating water in dairy:

Month	kw-hr. Used
August	2,010
September	2,010
October	2,140
November	1,870
December	1,510
	9,540

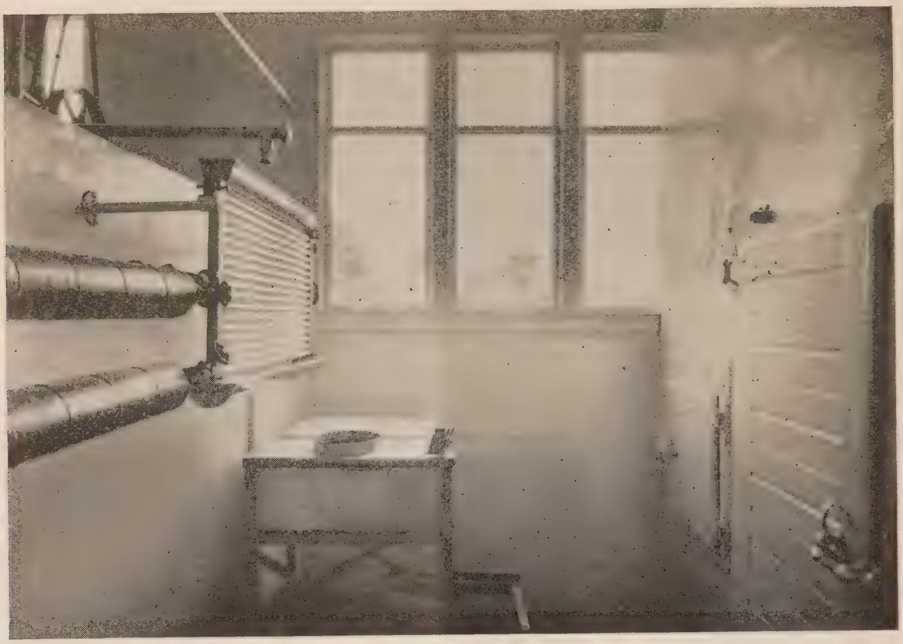


Fig. 3. Equipment for aeriating and cooling milk.

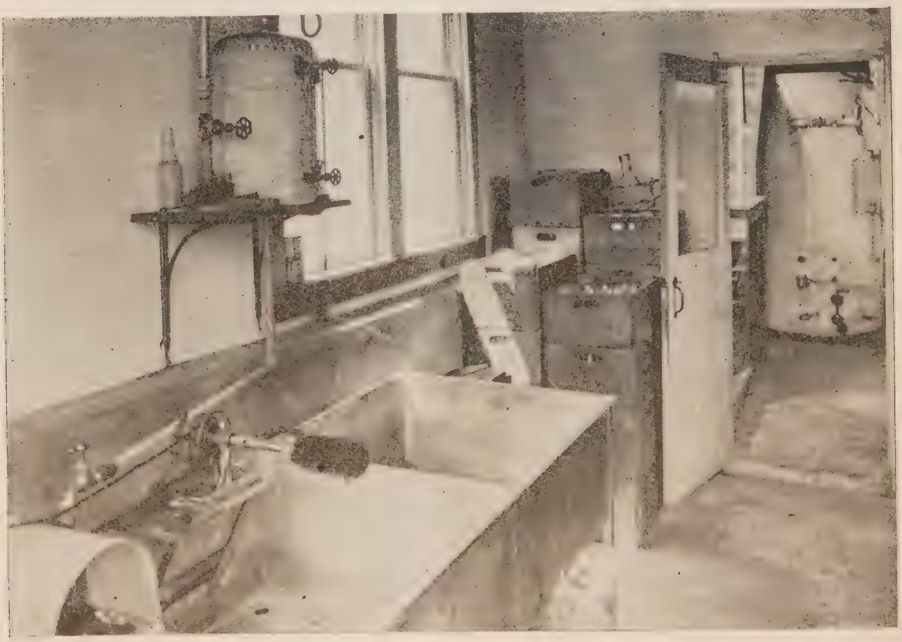


Fig 4. Bottle washer and hot water tanks.

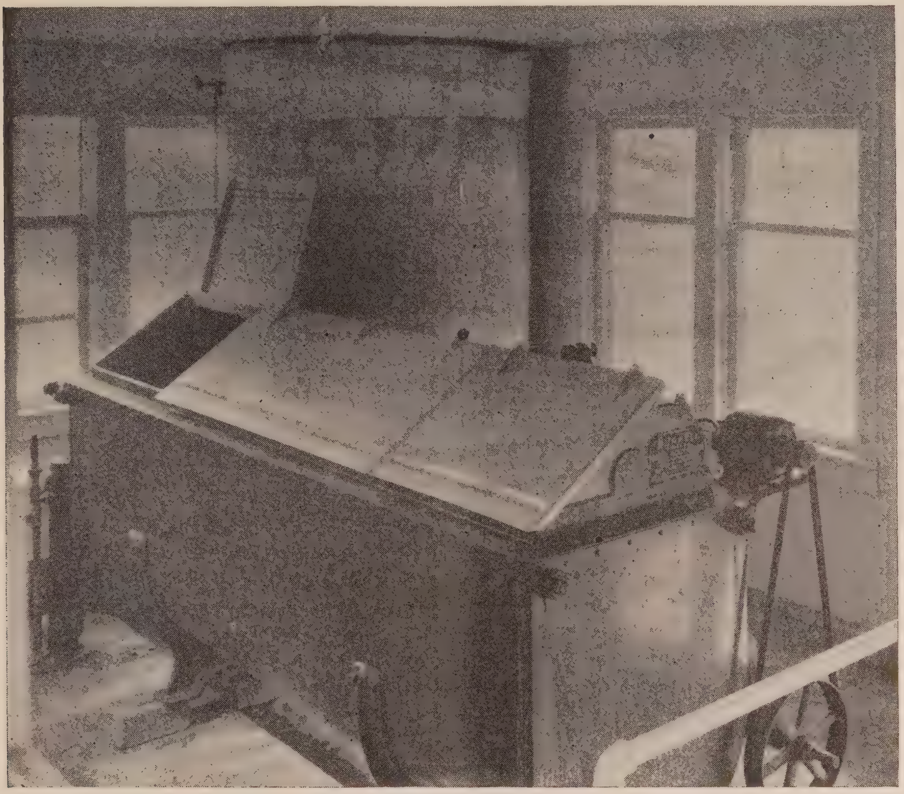


Fig. 5. Pastuerization tank, stirring mechanism driven by ¼ h.p. motor.

jacket with standard plumbing connection and forced draught supplied by a small motor-driven blower controlled by a thermostat, would give a cheaper and more flexible supply of hot water at a proper temperature. Of the total consumption about 70 per cent. of it is chargeable to this particular use and were it not for the fact that the water, after passing through the pasteurizer coils, is returned to the hot water tank with little loss of heat, the cost of this method of providing hot water might be prohibitive. It is to be noted that an improvement could be made in locating the water tanks in the building so as to further minimize losses and in that way decrease the amount of energy used for this purpose.

While this installation is most interesting, the set-up was made without first being brought to the attention of the Commission's engineers and this method of water heating for pasteurization should only be considered in exceptional cases. This young farmer is to be commended upon his enterprise in branching into a line which is only found in or close to large places, and we hope that his venture will meet with success.

How we are Approaching the Saturation Point Among Electrical Users in Ontario

ANOTHER year has passed, another survey has been made of the uses of electrical appliances among Hydro users in Ontario, and closer do we approach the saturation point where all electrical users will be using all major electrical appliances. The survey just completed indicating the number of appliances in use at the end of 1925 shows in the majority of cases that more and more people are becoming better acquainted with the advantages and economies of electrical appliance uses and the percentage of persons enjoying the use of a great many electrical appliances has increased very appreciably.

To prepare the figures contained in the table below it was necessary to send out a questionnaire to each Hydro Municipality asking for either an estimate on the total number of electrical appliances in each class in use in their Municipality or an actual count of the appliances in service and from the figures received indications point to the fact that a large number of Municipalities realize the value of information which tells how many appliances are in use on their lines because more actual counts were received for 1925 than we received for the previous year and where the actual figures were compared with the estimated figures of the previous year some differences were observed which showed that it pays to count rather than estimate.

In compiling the figures showing the total estimated number of appliances in use, averages had to be applied because of the fact that in a great many cases neither estimates nor counts were received from the Municipalities and by applying general averages made up of the figures which were received and taking into account the number of customers involved, a total estimate was arrived at which compared favourably in most cases with the total estimated figures for 1924. With the exception of the number of irons, toasters and grills in use, the 1925 estimates are higher than those of 1924 and the variations or rather the decreases in 1925 over 1924 in some instances are largely due to the inaccuracy in 1924 estimates which were corrected by counts in 1925, and we believe that the 1925 are a little more accurate on that account than the previous survey produced.

Considerable increase is noted in the total installed capacity of the appliances in use to the extent of approximately 30,000 kilowatts and taking into account the differences mentioned above it is safe to say that the total increase in installed capacity of electrical appliances among Hydro customers for 1925 was over 50,000 kilowatts, or roughly 67,000 h.p.

	Number of Municipalities reporting out of a Total of 247	Number of wired homes Represented by Reports submitted out of a total of 355438	Number of Appliances Reported in use Dec, 31st, 1925.	Number calculated from Averages of submitted figures as bieng total of Appliances in use Dec, 31st, 1925.	Percentage of Saturation.	Estimated total installed Capacities Killowatts.
Electric Ranges....	188	324,830	51,994	56,562	15.9%	339,372
Electric Hotplates..	172	196,013	8,359	15,321	4.3%	30,642
Electric Washers...	174	163,053	28,545	63,172	17.7%	12,634
Electric Vacuum Cleaners........	167	162,427	32,292	72,660	20.4%	14,532
Electric Water Heaters........	141	155,142	10,570	24,726	7.0%	49,452
Electric Grates....	115	145,520	3,348	8,724	2.4%	17,448
Electric Air Heaters	144	125,781	30,555	104,084	29.3%	83,267
Electric Ironers....	82	117,122	576	1,953	.5%	5,859
Electric Irons.....	171	147,348	104,963	286,141	80.5%	188,852
Electric Refrigerators............	57	116,339	388	1,345	.4%	269
Electric Toasters...	171	127,939	53,621	149,700	42.1%	82,335
Electric Grills.....	129	120,544	13,316	37,068	10.4%	24,472
Total Installed Capacity......						849,134

Appliances Sold by Hydro Shops During 1925

INFORMATION has just been received from all Hydro Municipalities engaging in merchandising on a large or a small scale of the number of appliances in the different classes which they have sold during 1925 and the table presented below indicates the sales by each Municipality of the various important appliances in use to-day.

If the figures showing the sales in 1924 and as published in the August 1925 Hydro Bulletin are examined and compared with the figures in this table some differences between the sales of the two years will be noted.

In the larger Municipalities the sales of ranges, washing machines, vacuum cleaners and water heaters are less in practically every case than they were the year before. This may be due to the fact that Electrical Dealers and Department Stores are receiving the benefit of Hydro advertising in its various forms and are increasing their efforts to sell electrical appliances in an easy market. It may also be due to the fact that better terms can be ob-

tained from Electrical Dealers, especially the larger ones, who do not charge interest perhaps, or who allow a small down payment and who can make up their losses by volume of business.

The shrinkage in sales may also be caused by the fact that those to whom electrical appliances can be sold now are in the majority of cases people who, while they require electrical appliances to make life easier, are not in the position to pay cash or a substantial down payment to purchase these appliances, and that it is correspondingly harder to sell appliances than it was some years ago. When Hydro Shops were first opened up the cream of the population were among the first customers and once selling started it could hardly be stopped, but now-a-days customers have to be ferretted out and it is a hard job to make sales.

Notwithstanding these facts, Hydro Shops are still contributing a great deal toward saturating the electrical appliance field and undoubtedly the work carried on by Hydro Shops is responsible for a great many sales by Electrical Dealers and others who are spurred on by Hydro competition or to take advantage of Hydro service arguments to sell their appliances:—

	Ranges	Hot Plates	Washers	Vacuum Cleaners	Water Heaters	Grates	Air Heaters	Ironers	Irons	Refrigerators	Toasters	Grills
Acton	9	5	10	2	3	1	6	..	10	..	4	5
Belleville	70	5	49	40	30	..	35	..	52	..	30	8
Bowmanville	18	17	13	10	12	2	21	1	65	..	35	12
Brighton	1	1	5	4	..	..	6	..	10	..	31	1
Chatham	18	11	..	3	9	1	25	..	65	..	100	6
Chesterville	1	..	1	1	..	..	2	..	8	..	..	..
Clinton	7	6	1	3	3	..	8	..	9	..	8	..
Cobourg	4	..	8	7	1	..	19	..	42	..	28	5
Collingwood	17	..	..	..	2	..	2	..	15	..	1	6
Elmira	1	..	1	1	..	..	6	..	10	..	3	6
Exeter	11	2	6	1	5	2	8	1	20	1	10	3
Forest	7	5	5	2	8	1	10	3	18	..	16	..
Galt	109	72	37	5	14	6	34	1	108	..	73	7
Goderich	10	1	3	1	1	..	5	1	14	..	12	..
Guelph	23	..	..	..	6	3	13	..	6	2	13	6
Hamilton	567	24	213	142	76	17	31	3	218	..	98	1
Kemptville	1	2	1	2	..	..	2	..	5	..	3	2
Kincardine	3	1	1	..	2	..	..	1	2	..	..	..
Kitchener	158	36	51	2	8	7	67	3	40	7	..	..
Lindsay	5	1	..	..	4	..	5	..	32	..	16	..

	Ranges	Hot Plates	Washers	Vacuum Cleaners	Water Heaters	Grates	Air Heaters	Ironers	Irons	Refrigerators	Toasters	Grills
London	374	39	302	144	45	30	147	6	271	29	186	30
Midland	39	44	78	9	18	5	47	3	106	7	22	46
Milton	3	2	1	..	..	..	3	1	21	..	10	1
Mitchell	12	5	6	7	1	3	7	..	20	..	12	1
Napanee	10	8	15	5	20	2	3	1	20	2	10	10
New Hamburg	12	2	16	12	3	2	5	..	8	..	7	3
New Toronto	4	..	2	..	2	..	3	..	3	..	1	..
Niagara Falls	55	5	2	1	19	1	5	..	18	..	17	5
North Bay	11	5	6	6	9	..	10	..	65	..	19	6
Oil Springs	1	..	4	..	..	..	1	..	6	..	5	1
Ottawa	98	3	..	..	37	..	..	..	..	..	..	..
Owen Sound	10	3	3	1	10	1	1	1	16	..	15	12
Palmerston	3	3	3	..	3	2	5	..	15	..	..	1
Penetang	1	..	1	..	1	..	..	1	2	..	..	..
Perth	15	12	3	3	7	4	11	..	22	..	6	55
Peterboro	18	10	9	..	40	2	3	1	15	..	8	2
Petrolia	4	1	7	1	5	..	8	..	16	..	9	5
Picton	16	19	..	2	15	2	32	..	33	..	31	1
Port Hope	8	2	..	2	4	..	..	..	18	..	..	..
St. Mary's	24	7	6	2	4	..	15	..	25	..	10	2
St. Thomas	60	50	96	30	21	12	68	4	52	3	111	15
Sarnia	100	44	105	39	8	4	35	3	125	..	98	5
Seaforth	9	4	5	..	4	1	6	1	11	..	..	8
Stamford	138	14	94	29	48	16	..	1	33	..	26	9
Stratford	126	32	72	18	25	19	38	1	86	..	31	19
Strathroy	23	13	10	8	6	2	20	..	42	..	11	20
Tillsonburg	6	2	13	..	..	1	6	..	15	..	10	..
Toronto	632	107	496	670	148	..	..	35	4750	6	844	543
Trenton	12	15	21	3	3	..	9	..	27	..	7	13
Tweed	..	4	1	1	..	..	..	..	4	..	2	4
Walkerville	664	105	217	99	49	23	169	21	264	47	99	15
Wallaceburg	7	3	10	9	3	..	32	..	30	..	24	2
Waterloo	37	3	..	2	12	..	6	..	15	..	8	..
Winchester	4	2	5	2	2	..	5	..	15	..	5	4
Windsor	988	159	264	106	122	37	175	6	530	4	140	32
Wingham	3	24	9	1	2	..	7	..	55	..	35	15
Woodstock	47	9	1	4	9	15	4	.	11	..	10	..
Total Sales 1925	4612	949	2268	1442	889	224	1201	110	7514	109	2412	953

Hydro-Electric Power

(Extracts from The Electrician, London, July 9th, 1926.)

IT is no exaggeration to say that hydro-electric power is a potent factor in the present serious situation in the coal industry. For though it is a platitude that electricity has revolutionized modern life, many electrical engineers do not realise the extent to which electricity has enabled water power to be developed so that the supremacy of coal no longer exists. The advance is really staggering, and of course has only been rendered possible because a large amount of energy in a given spot can be distributed by means of a network of wires almost to any distance. According to the United States Geological Survey, the potential inland horse power in the world, based on conservative figures of 70 per cent. of the normal output for 70 per cent. of the 24 hours, is 453,000,000 h.p., of which 190,000,000 h.p. is in Africa, the drainage area of the Congo representing the greatest of all sources of energy. At the end of 1921 the world's output of water power was 23,000,000 h.p., while in 1923 this had become 29,000,000 h.p., and to-day the figure is over 35,000,000 h.p. The rate of advance is therefore enormous, being, for example, 26 per cent. between 1921 and 1923.

In 1921 Europe had 8,877,000 h.p. at work from water, but by 1923 this had increased to no less than 12,300,000, that is, over 40 per cent., much more rapidly that is than in the United States and Canada, where the figures in 1921 were 12,210,000 h.p. and in 1923, 13,700,000 h.p. The huge developments in the use of electricity because of water power in many different countries of the world are in fact almost incredible. Thus, in 1923, Japan was generating 1,694,000 h.p. by water and France 2,100,000 h.p., whereas in 1921 the figure for France was 1,400,000 h.p. Every possible attempt is being made by the latter country to render herself independent of foreign coal and liquid fuel, and certainly to-day well over 2,500,000 h.p. is being obtained from water, so that we can regard the coal trade with this country as almost lost, while the same is beginning to apply to Italy. Further, it may be mentioned that some time ago there was opened up the River Barberine hydro-electric plant in the Canton of Valais, which will practically render Switzerland independent of imported coal.

Almost everywhere the same story is to be told, and in the Fifth Annual Report of the Federal Water Power Commission of the United States it is stated that during the five years of the Board's existence since the Water Power Act came into force in 1920 applications have been filed in America for water power projects totalling 24,000,000 h.p., and in this same period plant aggregating 2,646,000 h.p. has been set at work, representing 83 different schemes. In the year 1925, for example, there was put into service 1,500,000 h.p.

and orders were received for water turbines and similar machinery to the extent of 1,000,000. The developments in Canada are almost as remarkable. In 1925, 600,000 h.p. was set at work, including the Quebec Development Co.'s huge scheme of 400,000 h.p. at Isle Maligne on the Saguenay River near Quebec. This comprises eight 50,000 h.p. turbines. Further, it may be stated that the ninth unit of 58,000 h.p. was installed at the Queenston plant by the Hydro-Electric Power Commission of Ontario at the Niagara Falls.

Water power turbines to-day are of enormous size. There is now, for example, on order in America a 40,000 h.p. impulse turbine for Brazil, in which country also rapid developments are now commencing, the total power in operation in 1923 being 450,000 h.p. Brazil has immense potential water power reserves estimated at 25,000,000 h.p., and one of the most important schemes is the Parahyba, for the supply of electricity to Rio de Janiero.

It is almost impossible to keep track of all the developments, but one of the most recent typical American medium-sized hydro-electric installations is the Catawba River scheme in South Carolina, for the Southern Power Co. of Carolina, on a site 20 miles south of the town of Charlotte. This is of 75,000 kw. capacity, and comprises four Allis-Chalmers vertical single-runner Francis type turbines, operating at 70 ft. head at 100 lb. per min., driving General Electric alternators of 19,750 kw. each.

To-day, hydro-electric plants are at work from all heights of 7 ft. to 3,000 ft., and obviously they have very many advantages, being clean and efficient. Their wear and tear, maintenance and labour costs are small, and they give no trouble with dust, smoke, ash and clinker. More important still, they represent a steady and safe investment, much more so in fact than the steam-driven electricity station, and equal to irrigation schemes, which are also rapidly becoming one of the most important fields of engineering work.

Association of Municipal Electrical Utilities

Minutes of Executive Committee Meeting

A meeting of the Executive Committee was held at the office of the Hydro-Electric Power Commission, on Wednesday, September 22, 1926. Those present were—Messrs. R. H. Starr, President, E. J. Stapleton, V. S. McIntyre, J. G. Archibald, R. J. Smith, C. T. Barnes, J. E. B. Phelps, T. J. Hannigan, G. J. Mickler and S. R. A Clement.

It was moved by Mr. J. J. Heeg and seconded by Mr. E. J. Stapleton That the Minutes of the last Executive Meeting be taken as read. *Carried.*

This meeting was called for the purpose of considering plans for the Winter Convention of the Association and such other business as was referred to it by the Summer Convention.

Mr. J. J. Heeg, Chairman of the Convention Committee, presented a report recommending that the Winter Convention be held at the King Edward Hotel, Toronto, on January 19th and 20th, 1927, and moved its adoption; on being seconded by Mr. Archibald, Mr. Heeg's resolution was carried.

It was suggested that the O.M.E.A. obtain speakers for the Convention dinner and the two Convention luncheons, to which Mr. Hannigan gave his consent.

It was also suggested that the Electric Club of Toronto be asked to attend the Convention luncheon on the first day.

The Chairman of the Papers Committee, W. R. Catton, not being present and not having presented a report, it was moved by Mr. J. G. Archibald and seconded by Mr. J. E. B. Phelps That this Committee be asked to obtain a paper from Mr. S. J. Ellis, Radio Inspector on "Radio Interference", also that Mr. F. W. Peek of the General Electric Co., Schenectady, N.Y., be asked to give a paper on "Lightning Arresters" and that another paper be presented on a subject to be selected by the Committee; That Mr. Mickler procure a playlet or a paper on some merchandising subject. *Carried.*

Referring to the resolution passed by the Summer Convention asking for the appointment of a Meter Committee, it was moved by Mr. V. S. McIntyre and seconded by Mr. R. J. Smith, That Messrs. J. E. B. Phelps, Sarnia; O. H. Scott, Belleville; W. P. Dobson, H.E.P.C. of Ontario, Toronto, and J. Eckerslie, Toronto Hydro, be appointed a Meter Committee with powers to add to their number, to take up the question of obtaining standards by municipal systems and any other matters that it should deem advisable to consider. *Carried.*

Mr. G. J. Mickler on behalf of V. S. McIntyre, Chairman of the Merchandising Committee, presented a report of that Committee and moved its adoption, and being seconded by Mr. Phelps, Mr. Mickler's motion was carried.

The meeting then adjourned.

We wish to record the marriage of Miss Edna M. Brown, formerly of Collingwood and the Public Utilities Commission's staff and later of 40 Hazelton Ave., Toronto, and this Commission's staff, to Mr. E. A. Hodgson, Superintendent of the Essex Rural Power District. The marriage was performed at Trinity United Church on August 31st, 1926. Mr. and Mrs. Hodgson have taken up their residence at Essex, Ont., and the Bulletin wishes to take this opportunity of extending to them both best wishes for the future.

Mr. R. M. Bond, of the Municipal Audit staff, has been in the Western Hospital for the past six weeks following a serious operation. His many friends will be glad to know that he is convalescing satisfactorily, having returned to his home a few days ago, and hopes to resume his duties early in October.

Hydro Radial Staff Loses Chief Clerk

It is with regret that we announce the death of Mr. David William Speedie in his forty-fifth year, at his home, 39 East Lynn Avenue, on Saturday, September 11th, 1926.

Mr. Speedie was Chief Clerk to Mr. W. R. Robertson, General Superintendent of Railways, and in addition held the position of Freight and Passenger Auditor of Railways.

The late Mr. Speedie was born in Toronto and received his education here, later becoming associated with the Canadian Pacific Railway at the Toronto Office. He was also connected with the Grand Trunk Railway before it was taken over by the Canadian National. On leaving the Grand Trunk Railway he entered the service of the Niagara, St. Catharines and Toronto Railway and Navigation Company, and was stationed for some years at various points on its lines, resigning to accept a position with the Hydro-Electric Power Commission when Mr. Robertson was appointed in charge of Railway Operation for the Commission. Mr. Speedie had been one of Mr. Robertson's valued assistants for seventeen years. Through his connection with Railways, he became a member of the Transportation Club of Toronto. He was a member of St. John's Anglican Church, Norway. He was also a member of the Masonic Order, under whose auspices the funeral was conducted to St. John's Cemetery. Surviving him are his widow, Edith Jones Speedie, and two children, Irene and Herbert.

During the time Mr. Speedie has been connected with the Commission, his ability and unfailing courtesy endeared him to all those whom he came in contact with, which was further evidenced by the numerous floral offerings. To his family our sincerest sympathies are extended.

Accidental Death of Cannington's Superintendant

It is with deep regret that we chronicle the death of Mr. A. Smethurst at Cannington on July 9th, 1926. Mr. Smethurst was employed by the Operating Department as patrolman on a portion of the Wasdells Division of the Georgian Bay System and also as Superintendent of the local systems in Cannington, Woodville and Sunderland. He met death by coming in contact with a 2300-volt wire while engaged in replacing a transformer, following a very severe electrical storm in the district.

Mr. Smethurst had been in the employ of the Commission for several years and was recognized as a very capable and experienced lineman. His passing is a matter of deep regret, not only to his fellow employees, but also to the residents of the district in which he was employed at the time of his death.

Funeral services were held at both Cannington and Toronto; interment being made in St. John's Norway Cemetery on Monday (July 12th).

Shooting at Insulators Results in Death of two

In a recent issue of the Great Falls (Montana) Tribune is the story of the deaths of a man and a 12-year-old boy, killed by coming in contact with a wire fence that had been charged from a fallen high tension power line.

This affair has interest for every individual, as well as for those concerned with the problems of high tension power transmission. It is an example of the result of unthinking and irresponsible action on the part of persons who do not see any farther than the end of their noses. Some one had shot at and shattered the insulators on this power line with the result that one of the wires had fallen across the wire fence.

Witnesses at the coroner's inquest said that they did not see a power wire near the scene of the accident, but that the actual contact was *four or five blocks away.*

Evidence showed that the power company had used standard equipment in the construction of the power line and that at least 13 insulators had been shot away. The fallen wire was from a pole which stood at an angle with the other poles, the release of the power wire giving enough slack to permit it to fall to the fence. A piece of a bullet was found in one of the insulator pins.

The incident will probably be a lesson to the people of that locality who might be inclined towards random use of firearms and furnishes good material for power companies generally, in their effort to forestall irresponsible shooting at insulators.

—"*O-B Bulletin*".

HYDRO NEWS ITEMS

Central Ontario System

The Engineer and Construction Co., who have a contract for a government dam on the Trent River near Peterboro, recently suffered a severe burn-out, their outdoor transformer station being almost totally destroyed. This has now been rebuilt and new transformers installed.

* * * *

The Hinde & Dauch new factory at Trenton is now under construction. It is expected that they will be taking 250 h.p. early in the new year.

* * * *

Estimates are being prepared to provide for the growing load at Whitby and in the Pickering Rural District. Either the present 4,000 volt line will be double circuited or a new 44,000 volt line will be built.

* * * *

New rural power districts around the city of Belleville and the town of Cobourg are being prepared in order to take in the many scattered rural lines in these sections.

* * * *

Georgian Bay System

The new semi-automatic generating station at Hanna Chute which has been under construction during the past year will be placed in operation at the end of this month. This development will be known as Muskoka Generating Station No. 2 and consists of one vertical unit with a turbine rating of 1,550 h.p. This station will be remote controlled from the switchboard at the Main or No. 1 station. A more complete description of this development will appear in a later issue of the Bulletin.

* * * *

The Commission has completed the restringing of the 22,000 volt transmission line between Beaverton and Cannington on the Wasdells Division replacing both circuits which were originally steel conductor with No. 2 steel reinforced aluminum, and it is anticipated that this change will greatly improve voltage conditions at the south end of the Wasdells system.

* * * *

The line construction for the distribution system in the new Georgian Rural Power District has been completed and service will be inaugurated about October 1st. The summer resort district at Port Bolster on Lake Simcoe and the unincorporated village of Pefferlaw is included in this district. Electrical energy will be obtained from Beaverton substation through a portion of the Beaverton distribution system, the new rural line originating at the end of the Cedarhurst Maple Beach feeder.

Considerable activity has been shown by both summer and permanent residents in the Muskoka district in the vicinity of Beaumaris and Rosseau. Meetings have been held in both localities and local Committees are working on a canvass for the purpose of securing the contracts which are necessary to enable the Commission to proceed with the construction of transmission lines for serving these districts.

* * * *

Work was completed on a ten mile rural extension in the Sparrow Lake district early in July, making service available to a large number of farms, summer hotels and cottages bordering on the lake. Power is supplied direct from the Wasdells generating plant, and the district as it now stands, including the hamlets of Washago and Severn Bridge, provides service to a total of 91 consumers.

* * * *

Niagara System

The International Nickel Company recently signed a contract with the Commission for a large additional block of power for the operation of a new extension to its Port Colborne plant. This contract will be operated with considerable advantage to the Niagara System in reducing the generating capacity required during the peak months of the year as this additional power is interruptible during the peak load hours in the winter months.

* * * *

Arrangements are being made for the extension of transmission line from Aylmer to Port Burwell, a distance of approximately twenty miles. This line will form part of the Aylmer Rural Power District. As the distance is too great for the 4,000 volt service available at Aylmer, it is necessary to step up the voltage supply from 4,000 volts to 8,000 volts. Special service transformers are being used for 8,000 volt service.

* * * *

A small half ton truck belonging to the Commission was recently struck by a fast express train near Paris. The truck was completely demolished, but the driver was only slightly injured. The fact that he was thrown against a wire fence, which served to break the force of the fall, no doubt was responsible for his life being saved. The crossing is an exceptionally bad one as the view of the track is very limited. It pays to STOP, LOOK and LISTEN.

* * * *

Ottawa System

The construction of a rural line extension to Stittsville is nearing completion.

* * * *

The construction of a rural line to Osgood, North Gower and Kars will be started at once, it being planned to have it in operation this year.

* * * *

The Nipean district is to be changed over to 8,000 volts, when there will be over sixty miles of primary line. A permanent super-

intendent will be put in charge of this district in October.

* * * *

St. Lawence System

A 4,000 volt single phase line is being constructed from the Village of Russell to supply rural service to residents of the Police Village of Embrun.

* * * *

An extension in the Apple Hill Rural Power District is under consideration to supply residents of the Hamlet of Monkland and the Police Village of Avonmore.

* * * *

Thunder Bay System

The preliminary work prior to actual construction at the Alexander development is progressing favorably. This work involves the construction of a railway siding as well as the transmission line and substation for supplying power to construction equipment and also the placing of construction plant. A certain portion of the permanent work will proceed throughout the winter and the entire job will be in full progress by the Spring of 1927.

* * * *

Approval has been received for the construction of the third transmission circuit between Cameron Falls and the Bare Point substation at Port Arthur. A part of the work will be completed this winter, especially at locations where winter conditions facilitate the carrying on of same to better advantage, and the entire new line will be ready for operation by the Fall of 1927. The work consists of erecting double circuit towers and lines thereon between Reserve Junction and Sprucewood, and the stringing of the second circuit on existing towers for the balance of the distance. The completion of this work will give the Commission three transmission lines between the developments on the Nipigon river and Port Arthur and Fort William, consisting of a single circuit on a wooden pole line and a double circuit on steel towers.

* * * *

The construction of both the 110 kv. terminal station and the Municipal distributing station at Walsh Street, Fort William, are making good progress and both will be ready to take over the delivery of power to the City from the Cameron Falls development at the expiration of the Kaministiquia Power Co.'s contract in December. The additional 110 kv. transmission line circuit between Bare Point, Port Arthur and the Walsh Street substation, Fort William, over which the latter will be eventually served, has been completed and will be used temporarily at 22,000 volts after October 1st, until Walsh Street station is placed in commission in December, to enable the local Commission to serve the G.T.P. elevator.

* * * *

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in August, 1926.

Appliances

THE COFFIELD WASHER CO. OF CANADA, LIMITED, 121 James Street S., Hamilton, Ont.

"Coffield" motor-driven, portable washing machine, Gyrator type.

Marking: Manufacturer's name on machine, nameplate with rating in motor.

* * * *

DURABLE ELECTRIC APPLIANCE CO., LIMITED, 81 Jarvis St., Toronto.

Rectifier, stationary type.

* * * *

THE GURNEY FOUNDRY COMPANY, LIMITED, 500 King St. W., Toronto.

"Gurney" Ranges, low oven and cabinet types, Cat. Nos. 502, 1003, 1004, 1006, 4303, 4304, 4902.

Marking: nameplate with rating.

* * * *

INTERNATIONAL BUSINESS MACHINES CO. LTD., 300 Campbell Ave., Toronto.

Meat Choppers and Coffee Mills. "International Business Machines."

* * * *

NORWICH ELECTRIC LTD., Norwich, Ont.

Bowl Type Reflector Heater.

Combination Bowl Type Reflector Heater and Grill.

* * * *

PHILIP GIES PUMP CO., LIMITED, Kitchener, Ont.

Electric-lighted Gasolene Pumps. "Philip Gies Pump Co."

* * * *

OUTDOOR ADVERTISING LIMITED, Corner Dupont St. and Davenport Rd., Toronto.

Electrically-illuminated display signs.

* * * *

J. FRANK RAW COMPANY, 56 Adelaide St. E., Toronto.

Stereopticon Type Picture Machines. "J. Frank Raw Company."

* * * *

THE ROBBINS & MYERS CO. OF CANADA, LIMITED, Brantford, Ont.

"Robbins & Myers" Ventilating Fans.

* * * *

THE WONDER MANUFACTURING CO. LIMITED, 77 Peter St., Toronto.

"Perfect" portable, motor-driven washing machine.

Marking: Nameplate with rating.

* * * *

*BERSTED MFG. CO., 5202-21 W. 65th St., Chicago, Ill.

Pressing Iron, Model No. 95A.

Electrically-heated cooking appliances.

Percolators, Model Nos. 188A, 405A.

Hotplates, Model Nos. 19A, 27A. Pressing Irons, Model No. 95A. Waffle Molds, Model Nos. 66A, 214A.

Marking: Nameplate with model number, rating and manufacturer's name and address.

* * * *

*LAMB KNITTING MACHINE CO., Chicopee Falls, Mass.

Portable automobile engine heater. "Wright."

Marking: "Wright" and manufacturer's name.

* * * *

*Minneapolis Heat Regulator Co., Minneapolis, Minn.

Automatic control and safety shut-off for oil burners.

Marking: "Type A" on etched nameplate attached to Protectostat cover and on etched nameplate attached to Protectorelay housing.

* * * *

*Petersime & Sons, Ira M., Gettysburg, Ohio.

Electric Incubators.

Marking: Nameplate with rating.

* * * *

*U.S.Light & Heat Corporation, Niagara Falls, N.Y.

Electric Welding Machine.

Marking: Nameplate.

* * * *

*Wilde Co., W. B., Peoria, Ill.

Hart "Type C" Oil Burner.

Marking: "Type C" cast as integral part of nameplate attached to main burner cover.

* * * *

Fittings

Weiss and Biheller, Inc., 69 Adelaide St. East, Toronto.

Fuseless, separable attachment plugs. "W. & B."

* * * *

*Metropolitan Electric Mfg. Co., Boulevard and 14th St., Long Island City, N.Y.

Cabinets and Cutout boxes, sheet metal.

Receptacles for Attachment Plugs & Plugs, Cat. Nos. 2043, 4110, 2052, 2054, 1074, 450, 461.

Marking: "Metropolitan."

* * * *

*Rodale Mfg. Co., 492 Broome St., New York, N.Y.

Receptacle for Attachment Plugs and Plugs, Cat. Nos. T-90, T-91, T-95.

Marking: "Rodale" moulded in raised letters on the face.

* * * *

Switches

*Metropolitan Electric Mfg. Co., Long Island City, N.Y.

"Metropolitan" Panelboard Switches, single-pole, Cat. No. 3014; double-pole, Cat. Nos. 3112-L, 3112-S, 12035.

Push Flush Switches, Single-pole, Cat. No. 2111; double-pole, Cat. No. 2112; Three-way, Cat. No. 2113.

"Metropolitan" Knife Switches, Type A, Type C.

Panelboards, Types NP, NPB.

* * * *

*Industrial Controller Co., Milwaukee, Wis.

Automatic Switches—Magnetically-operated type. Class 8526, 8527, 8533.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

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Hanna Chute Development on Georgian Bay System

THE recent extension to the South Falls plant on the Muskoka river necessitated additional forebay capacity to take care of the daily and weekly load fluctuations. This additional capacity could not be obtained in the existing forebay without considerable expense, on account of the low lying banks and extensive changes which would have been required in the headworks and dam.

At the upper end of the forebay the water entered through a narrow rock gorge, known as Hanna Chute, which presented a very favorable location for a dam and storage reservoir, by which the water could be backed up to the foot of Tretheway Falls, a distance of about two miles. This new storage reservoir has a normal elevation of about 30 feet above the South Falls forebay level, and advantage was taken of the potential power available in this head by installing a power plant in the gorge as an integral part of the regulating works, this new plant being distant 2500 feet from the South Falls plant.

From the north side of this Hanna Chute power house a concrete gravity wing wall extends a distance of about 115 feet to the rock bank, while on the south side a similar gravity wall 40 feet long joins the power house, with three 16 foot sluices and a spillway section 56 feet long.

The gravity sections for the greater part of their length have a top width of 3 feet with vertical upstream face, and a batter of 7½ to 12 on the downstream side. The maximum height of this section is about 25 feet. North of the log slide, where the height does not exceed 10 feet, the top width is reduced to 2 feet.

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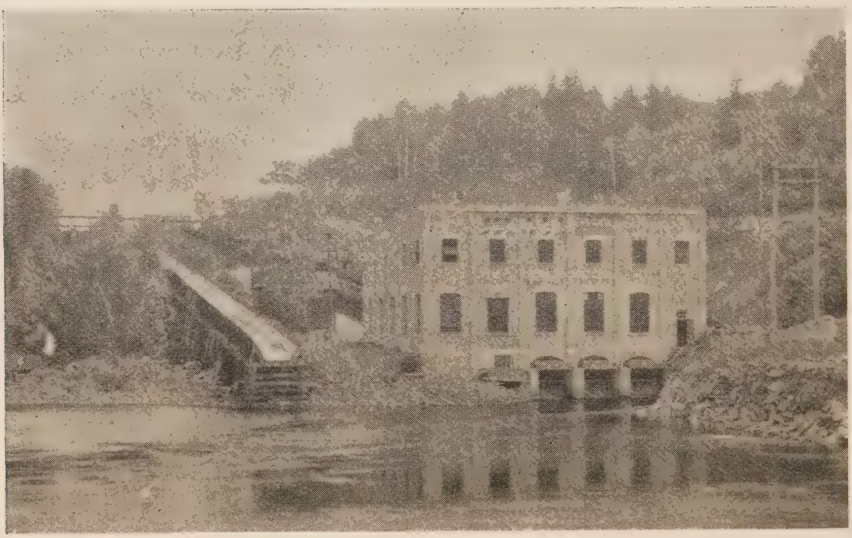
The sluiceways have a deck width of 18 feet 9 inches to provide storage space for stop logs and facilities for handling same. The piers have a thickness of 4 feet, and are spaced on 20 foot centres, giving a clear opening between each of 16 feet.

The power house substructure is of reinforced concrete construction, and is located in the gorge between narrow rock walls. The headworks is built integral with the power house substructure and is equipped with racks and checks for stop logs, no headgates being considered necessary at the present time.

The main or operating floor of the power house is of reinforced flat slab construction, in which two steel girders are embedded for supporting the generator. The turbine chamber floor is constructed as an arch between the two rock walls of the gorge.

The draft tube is of the Moody spreading type, constructed of steel plate, with cone extended up to base of runner.

The turbine is of the single runner, propeller type, vertical shaft unit, rated at 1,550 horsepower under



South Falls Development.

30 ft. head, and was supplied by the Dominion Engineering Company Limited. It has an operating speed of 225 rev. per min. and is controlled by a Woodward governor fully equipped with automatic and remote control attachments for operation from the South Falls plant. Automatic gauges are installed to indicate the headwater level at both Hanna Chute and South Falls. These gauges are of the indicating type and are connected with indicators in the South Falls power house. This arrangement enables the operator to maintain the proper balance between the water levels in the two forebays.

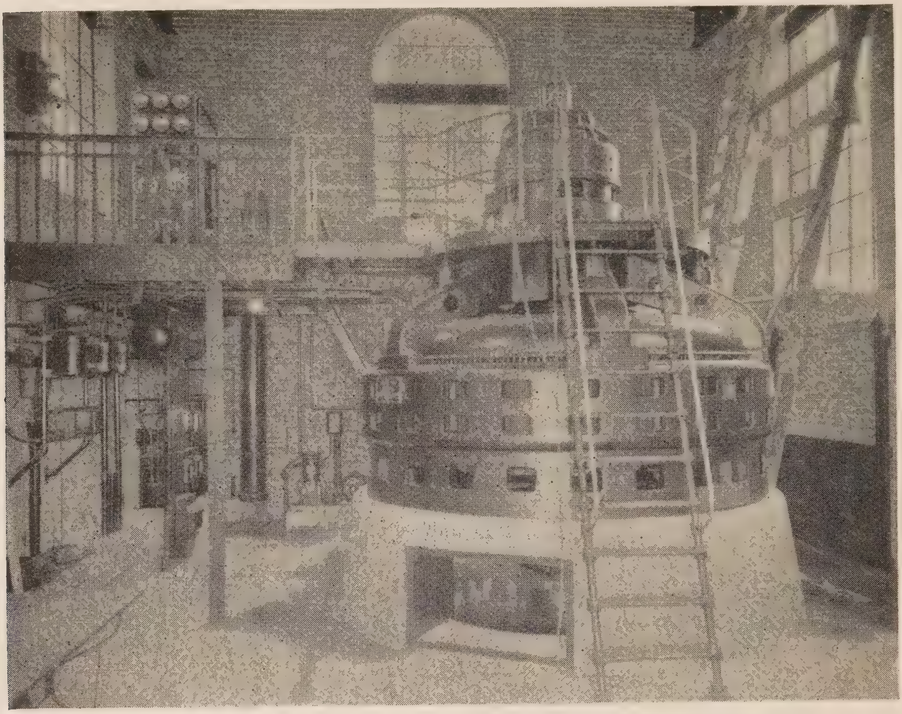
Under normal operating conditions the water will be discharged into the South Falls forebay through the Hanna Chute turbine. The plant was designed for operation from the South Falls plant by remote control, manual operation being required only in case of emergency, for repairs to the equipment and for the manipulation of the stop logs in the sluices when the unit is not running. The handling of the stop logs in both the headworks and sluiceways is done by two hand-operated crab winches, and the racks can be removed and replaced by means of a chain block attached to a trolley beam suspended from brackets near the roof of the power house upstream wall.

The superstructure is of pressed brick construction and houses one generator of Swedish General Electric Company fabrication with rated capacity of 1400 kv-a. 80 per cent. power factor, 3 phase, 60 cycle. 6600 volts and 225 rev. per min, No step up transformers are provided at this plant, the station feeding direct to the South Falls station bus at generated voltage, and the voltage stepped up there to system distribution voltage by means of the main power transformers at that plant which have been provided to handle this additional capacity.

The control for this unit is located at South Falls, and is handled by the South Falls operators in the same manner as the units in the main plant. By closing in a small carbon breaker at the control point, the Hanna Chute unit automatically starts and comes up to speed and normal voltage for synchronizing by hand at South Falls. The operator has push button control of the speed and voltage of the unit and can vary either or both to arrive at a condition of synchronism.

All load and power factor indications are recorded at the South Falls plant and the operators at that point can manipulate load conditions on both plants to pass sufficient water for the system load required without wastage.

Starting up the unit and also shutting down is entirely an automatic feature, the only human element being in the synchronizing of the unit with the system and the apportioning of load required from the unit. The plant is shut down by reduction of load by manual control at South Falls and tripping the breaker by hand which automatically clears the master control circuit to the plant thus starting the automatic sequence on the governor and control at Hanna Chute. This



Interior view of Hanna Chute Plant.

stops the unit and brakes the machine to rest. These brakes are of the oil pressure type and are automatically applied by the governor. They are also arranged for hand pumping. In cases of trouble the unit is promptly cleared from the system by relays provided for this purpose. In addition to the protective devices which are normally supplied in manual operated plants this generator has the following:—

(a) Thermostats of the dial thermometer type, on all bearings which function to operate a plant lock-out relay in case of excessive heating of any bearing. This relay shuts down the plant and prevents starting up until the trouble has been remedied, and the relay re-set by hand.

(b) Overspeed mechanical relay which locks out and shuts down the generator at 25 per cent. overspeed.

(c) Alternating Current overvoltage relay which shuts down the plant at 40 per cent. overvoltage. The plant can be immediately re-started without inspection if required.

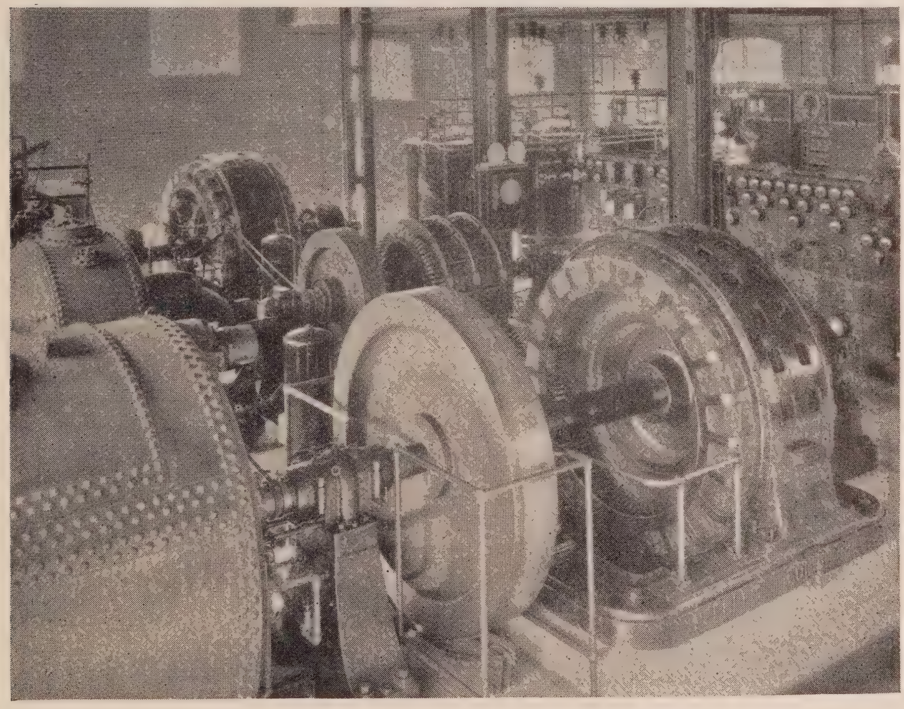
(d) Direct Current overvoltage relay which shuts down the plant at 140 volts on the exciter main bus.

A separate 6600 volt service feeder from the South Falls plant is pro-

vided which is stepped down to 110/220 volts by three 10 kv-a. transformers at Hanna Chute and supplies the service to all motors used in conjunction with the automatic features as well as to the control circuits. All tripping current is supplied from the control bus at South Falls. A seventeen conductor paper insulated control cable of power cable design runs between the two plants over which all control impulses and tripping circuits are established.

The generator is of the vertical type with a spring type thrust bearing to carry the weight of the rotor and turbine runner. The lubrication system is self contained, the oil being circulated by a pump from the reservoir of the lower guide bearing to the thrust bearing housing from which all bearings receive direct lubrication. The thrust bearing operates in an oil bath, the oil being cooled by passing it from the pump through a water cooler located on the turbine pressure plate in the generator pit before entering the thrust bearing housing. Cooling water is supplied at turbine pressure from the turbine pit.

The complete switching equipment and remote control apparatus was arranged by the Commission's Engineers. Standard contactor switches and relays were purchased from the different manufacturers and adapted to a circuit which is considered an ideal application to meet



Interior view of South Falls Generating Station.

the requirements for operation and protection.

The Construction work was carried out by the Commission's Construction staff. Work was commenced in the Spring of 1925 but was shut down during the winter months and carried to completion during the Fall of 1926, the plant being placed on load early in October.

This plant is the second of a series of plants which are ultimately to be constructed on the South Muskoka river, taking advantage of the various falls from the South Falls up to the Baysville Dam.

Lighting the Canadian National Exhibition

By H. D. May, Electrical Superintendent, C.N.E., Toronto

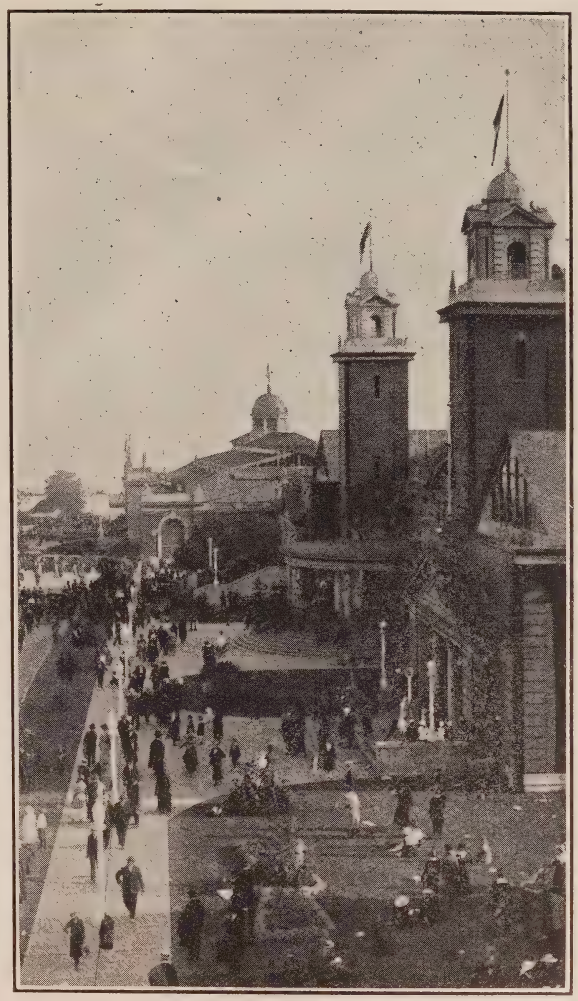
THE Canadian National Exhibition has come and gone once again, bringing with it and taking away that beautiful spectacle of light which we so naturally associate with night-time at the big Fair.

A few facts concerning the development and organization of the Electrical Department of the C.N.E. may be of interest to our readers. Contrary to popular belief, this Department is part of the Exhibition, and not of the Hydro System. It controls the distribution of light and power from Exhibition Substation, to its consumers throughout the Park and instals and maintains the whole electrical system within the gates, with the one exception of the 2200 volt primary equipment of the T.H.E.S.

Energy is received at Exhibition Station at 13,200 volts, is distributed therefrom at 2,200 volts, to local transformer banks in the buildings, from which it is carried, through networks of wires, as 110/220 volt single phase or 550 volt three phase, to every Exhibition booth. Each of the thousands of Exhibits must be wired to comply in every respect with Inspection Department regulations.

But, apart from the general supply of energy, there are many phases to the work of the Electrical Department. A few of these may be mentioned in Street Lighting, Building and Outline Lighting, Spectacular effects and signs, stage illumination, underground cable installation, overhead line construction, sign design, manufacture and erection, to all of which are added the general maintenance of the plant and the supply of light and energy to any special attractions which may be held in the Park, during the year.

Most of us can remember the days when the Midway was sawdust under foot and that sickly whitish light overhead emanated from the flaming arcs. In those days, it was necessary for a man to overhaul and trim the lamps once every two days in order to be reasonably sure of operation. To-day, these lamps have been replaced with modern steel reflectors with 1000 watt Type "C"



A section of Exhibition Park, looking South from Dufferin St. Entrance.

lamps, supplemented by streamers of 15 watt lamps. The lighting standards throughout the Park have been replaced by modern pillars supplied by underground feeds. The practice being followed to-day is that of laying tile duct along each street, with service boxes at convenient locations for laterals to be taken to the lamp posts. This is the result of much bitter experience from worn out lead and steel armored lead cables having to be changed. Some of the old cables have been in use for fifteen years, laid under the sod and it has been necessary to disfigure the lawns to locate and remove them.

Building lighting, including the outlines, means a great deal. Each reflector, lamp and outline socket must be gone over at least once each year, to make sure that no fault will occur after all exhibits are in place and the crowds make it impossible to shoot trouble quickly. Each of the large buildings carries about one thousand sockets in the outline, which must be repaired each year and totally replaced every ten years. This outline effect, when combined as it is, at Dufferin Gate with spectacular flashing signs, is very attractive. The Main Entrance has been described by many who should know, as the prettiest gate in America. However that may be, there are eight thousand lamps, each doing its part in supplying color and dash to the general scheme. Mill type daylight blue lamps are used for the sign; mill type clear, for the outlines and mill

type sprayed and dipped, for the color effects. The thousands of colored lamps in the scrolls and designs are blended by the staff and when the diamond and circle kaleidoscope set pieces, set in a flashing border on the tower faces, go through the series of eight design changes, the results are exceptionally lovely.

The magnitude of the work required to prepare for the two weeks' show, may be judged alone from the fact that there are over two dozen large electric signs, each of which is larger than the average downtown sign and every one is erected, lamped, tested and made ready for operation within two weeks of the opening date. During the past two years, the design, construction and erection of signs has been taken in hand almost entirely, by the electrical department, until now, it is in a position to supply all Exhibition demands, from its private shops.

From a consideration of the illumination of the buildings, we approach a new phase of the work, entirely, in the lighting of the Stage and Scenery for the Spectacle. Here is the masterpiece of the Electrical Department. From an average light intensity of one foot candle, a few years ago, it has been gradually improved, until, this year, an intensity was obtained on the stage, of over ten foot candles. This result has been achieved by much careful testing and experimenting, by discarding inefficient floods and substituting the most modern lamps obtainable on the continent. In addition to 60-1000 watt floodlight projectors, there is a bank of 10-1500 watt narrow beam floods and fifteen arc spotlights, varying in size from 30 to 100 ampere capacity.

These latter lamps are supplied from a 100 kw. motor-generator set which is located in the Grand Stand basement, directly beneath the lamp house. Supplementing this set and used only as an emergency, is a 50 h.p. gasoline driven generator which is called into service, only in case of a total interruption in the Hydro. Switchboards, dimmers, spots, color screens and, in general, all the equipment used on the roof and behind the scenes, is of the latest pattern and the most efficient it is possible to obtain.

To keep such a system in order, it can easily be understood, that a staff of men is required, day in and day out, winter and summer, laboring to eliminate as far as men can do, any possibility of breakdown when the big switch is closed and the lights of Exhibition City sparkle once again.

For Exhibition is a city, without a doubt, and the Electrical Department is its central station, catering to the needs of exacting consumers, from the smallest lamp to the enormous load of the Midway Shows.

The Toronto Load Totalizer

A description of the Thermo-Electric System of Transmitting and Totalizing Power Readings, as used in the Measurement of the Total Load supplied to the City of Toronto, by the Hydro-Electric Power Commission of Ontario.

THE modern practice of supplying a power network from a number of more or less widely separated points, has given rise to the problem of obtaining on one instrument an indication or record of the values of load on a certain remotely located feeder or group of feeders, and, in many cases, of obtaining a summation of the loads in several different stations. If energy consumption be the only quantity of which a total is desired, this, of course, may accurately be determined by adding the registrations of watthour meters on the several sections of the load; but where the required information takes the form of an instantaneous reading or a permanent record of the total load, means must be provided for interconnecting the metering systems of the several elements entering into the total, and for obtaining at all times a measurement of the resultant response. Within the limits of the power station the ordinary methods of metering are usually quite adequate to permit of a reading of the load on any part of the station being obtained in any other part; but, beyond a few hundred feet of transmission, the secondaries of the current transformers become so burdened that the cost of eliminating serious errors becomes prohibitive.

While the total load of the City of Toronto was supplied through one terminal substation (Strachan Ave.), the totalization of this load was accomplished in a most satisfactory manner through the agency of a pair of multiple-element Staebler and Baker graphic meters, one functioning as a wattmeter and the other as a reactive volt-ampere meter. But with the addition of other terminal stations in the city, the determination of instantaneous values of load for dispatching purposes and the selecting and measuring of the true system peak as a basis of establishing the monthly bill became increasingly difficult; and by the time four stations, having quite different load characteristics were included in the total, the problem of obtaining a satisfactory summation of the loads from the readings of four graphic wattmeters, however perfect in themselves, presented difficulties almost insurmountable.

With the above facts in view there was made a careful study of the schemes available for accomplishing the desired summation upon a single recording instrument, to be located at some convenient central point. Probably the first large installation embodying the transmission and totalization of power readings is that placed in service on the system of the Chicago, Milwaukee and St. Paul Railway about 1919.

This was what is known as the "inverse current" method, and embodied much auxiliary equipment, the transmitting unit in each station being actuated by a wattmeter element of particularly heavy and powerful design. Since then there have been developed an installed with varying success a number of methods, making use of almost every variable which can be associated with the electrical circuit, for the purpose of securing the quantitative feature. These schemes have been based upon variation of current, voltage, frequency and phase position, as well as on change of ratio of two electrical quantities and upon the periodicity of impulses transmitted from watthour meters. In all, nine distinct methods were investigated before it was decided that a system better suited to the case in hand than any of those available could be developed in the Commission's Laboratories, and at an estimated cost, including development charges, to compare favourably with that of any of the systems offered.

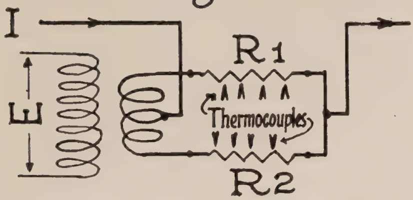
Attention was accordingly concentrated upon what might be called an "electro-thermo-electric" method, based upon the work of Mr. R. S. Fawsett in England, coupled with the electrical circuit of the Lincoln demand meter and a suitable recording instrument. This system, which may be briefly styled the "thermo-electric" system, presented a number of attractive features, the principal of which were that the transmitting units would contain no moving parts, and that a standard type of graphic instrument combining high precision with an inherently long scale could be emyloyed as a recorder.

Beside the transmitting circuit, the thermal method combines three elementary parts, which may be named as follows: (a) The circuit of the thermal wattmeter; (b) A series of thermocouples associated with the thermal wattmeter; (c) A zero method of measuring the voltage set up in the thermocouple circuit. The first two elements are combined into what is known as the "thermal converter", while the last takes the form of a continuously recording potentiometer.

The Thermal Wattmeter.

The principle of the thermal wattmeter has found considerable practical application, particularly in the Lincoln Demand meter, referred to above. The essential circuit of this device is shown in Fig. 1. To the primary of the small transformer is applied the voltage of the circuit under measurement, causing a current to circulate in the secondary coil and the two resistors R1 and R2. The current of the main circuit passes between the mid-point of the transformer secondary and the junction of the resistors. If these resistors are of equal value and the tap in the exact mid point of the transformer, the values of heat energy generated in the two resistors will differ by an amount directly proportional to the watts in the metered circuit; and if equal facilities are provided for dissipating this energy, the resistors will attain temperatures differing by a similarly proportioned amount. This combination is in-

Fig. 1



Elementary circuit of the Thermal Wattmeter in relation to Thermocouples.

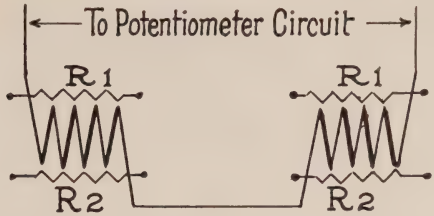


Fig. 2

Thermocouple circuit in relation to Heaters.

herently free from errors due to change in power factor, voltage, current or wave-form; and by proper design it can be made immune to outside temperature influences.

The Thermocouple Circuit

In a circuit made up of metals of different composition any difference of temperature existing between two of the junctions will set up in the circuit a thermo-electromotive force whose value is almost exactly proportional to the difference in temperature of the two junctions. The principle of the thermocouple has found very wide application in temperature measuring devices, and to a lesser extent in electrical measuring instruments used for high frequencies. In practically all these instances, however, the quantity under measurement is made responsible for affecting the temperature of one of the junctions, and the other,—the so-called "cold end",—either maintained at a constant temperature or else included in some system of temperature compensation. Since, in the scheme under consideration, the quantity to be measured is not a temperature but a temperature *difference*, the principle of the thermo-electric circuit lends itself particularly well to the solution of the problem; and by associating thermocouples with the respective heating resistors there is obtained an electromotive force proportional to their temperature difference, and therefore to the watts in the A.C. circuit. The general arrangement of the thermocouple circuits in relation to the heaters is shown in Fig. 2, which serves also to illustrate the embodiment of two metering elements in one thermal converter.

The Thermal Converter

The development of a thermal converter combining the principles of the two circuits mentioned above was carried out by the Lincoln Meter Company of Canada, in consultation with the engineers of the Hydro-Electric Power Commission of Ontario; and the working out of a practical application of the involved principles necessitated the solution of many unexpected problems in design. In the earlier experiments an effort was made to adhere to the

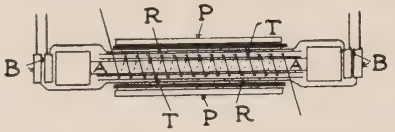


Fig. 3
Diagramatic Section of Converter Element.

orthodox methods of mounting thermocouples, and maintain thermal isolation between hot and cold junctions; but while good sensitivity was shown by this arrangement it was not found possible to obtain reasonable accuracy or constancy of results. In the final design, based upon a model constructed by Mr. H. S. Baker, most of the traditional thermocouple practices were discarded, and structure evolved in which a very close thermal association was obtained, not only between heaters and thermojunctions, but between the "hot" and "cold" ends of the couples. A diagram of this element is shown in Fig. 3. The whole is built up on, and supported by a rather massive brass or copper plate A, which serves as the backbone of the structure. Electrically insulated from this plate by thin strips of mica are the thermocouples T, T. These are prepared in the form of a wire made up of alternate sections of copper and constantan, and wound upon the central plate in such a way as to bring alternate junctions upon opposite sides. Each end of this winding is terminated by a copper wire, which is led to the external circuit. Outside the couples, and separated from them by thin mica plates, lie the heaters, R,R, which constitute the resistors of the thermal wattmeter; and beyond these in turn lie thick plates of insulating material. The whole is clamped together by heavy bolts engaging copper plates, P, P, on the outside of the element; and these plates are arranged to have good thermal contact with each other and with the central plate A.

With the element as described above, the whole temperature difference between the thermojunctions depends upon heat conduction, as related to the energy dissipated in the resistors; and the couples furnish a measure of the temperature gradient so established within the structure. The disturbing features of convection and radiation being entirely eliminated, there is obtained between watts in the A.C. circuit and millivolts in the thermoelectric circuit a much more definite relationship than could otherwise be expected. The compactness of the structure is such that the temperature gradient establishes itself in a remarkably short time, the interval in the elements as built for the Commission being 8 to 9 seconds for a 90 per cent. change. At the same time, it would not appear difficult to proportion the unit in such a way as to introduce a considerable time lag, in case measurement upon a demand basis were desired. The blocks B, B, to which the heater strips are led by thin copper ribbons, are thermally associated with each other and with the frame of the element, thus effectually preventing any errors which might arise from conduction of heat along the connecting wires.

Where totalization of several loads is concerned it is necessary that a constant proportionality be main-

tained between the value of the power measured, and the magnitude of the variable which represents it in the totalizing system. In other words, it is essential that each converter operate according to a linear law. Now the relation of thermo-electromotive force to temperature difference is not strictly linear, the tendency being toward the generation of higher potentials at higher temperatures. It was found possible, however, by proper proportioning of the element, to compensate for this characteristic to such an extent that up to double load in the system, the deviation from a straight line law is almost imperceptible.

Each thermal converter embodies two thermal wattmeter systems and two of the elements described above, the whole being enclosed within a case similar to that of the Lincoln indicating demand meter, as illustrated in Fig. 4. The connections of the A.C. circuits are identical with those of the Lincoln meter, and the rating is suited to the ordinary ratios of instrument transformers. The thermo-electric circuit is brought to terminals at the bottom of the case, the two elements being placed in series within. While there are provided, readily accessible inside in the case such adjustments as might be required, experience has shown that, the converter being entirely free of moving parts, and all elements thoroughly aged in manufacture, these adjustments, once set in the factory, are not likely to require further manipulation.

The Transmitting Circuit

The thermo-electromotive forces set up in each converter being in proportion to the power flowing in the corresponding A.C. circuit, it is only necessary to place in series the thermocouple terminals of the con-

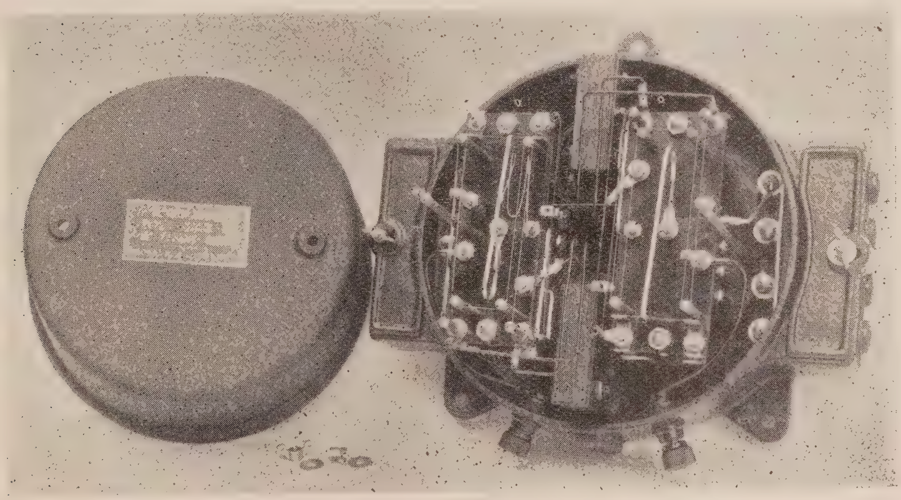


Fig 4. Thermal Converter with cover removed showing adjustments.

verters intalled on a number of feeders to obtain an electromotive force representative of the summation of the loads on these feeders. For this purpose there is required a circuit into which may be looped all the converters included in the totalization; and in this circuit must be included an instrument which will provide an indication of the total of the potentials established in the several converters. As the total voltage within the circuit is very small, and as the current demanded by a suitable instrument is almost negligible, a very simple circuit will suffice; and the main precaution becomes one of keeping stray electromotive forces from finding their way into this circuit. To eliminate the possibility of electrolytic, thermoelectric or other parisitic electromotive forces being set up within the system, it is essential that all connections be clean and secure. It is necessary, too, that the line be well guarded against the possibility of potential differences finding their way into the circuit by leakage or induction. While a two-conductor lead-covered cable would be ideal for this purpose, it has been found that satisfactory operation may be obtained through ordinary telephone cable. A number of tests made with "Style B" wire show that, for short outdoor runs, even under severe conditions of moisture, good performance may be expected. In the Toronto installation temporary connections were made through lead covered telephone cables, partly in ducts and partly overhead, in a twisted pair, along with other pairs carrying battery potentials as high as 50 volts, and ringing currents at 150 volts. The permanent connection is through pairs provided in cables of the supervisory control system.

The Recording Instrument

If an indication or record of the load upon but one feeder were required, it could be obtained with an instrument of the millivoltmeter type fed directly from the thermoelectric circuit of the converter; but, due to resistance of the circuit, and to the "Peltier effect" of the thermocouples, the scale would not be of uniform proportionality, and a non-linear relationship would exist between power in the metered line and current in the measuring coil of the instrument. A further source of error would lie in changes of resistance in the communicating circuit. Since, it is imperative that each individual converter in a totalizing system follow a linear law, it becomes apparent that such measurements as are made upon the potential set up in the circuit must be performed by zero or null method, which does not draw any current from the thermocouples at the time of measurement. While there are several methods by which this might be done, the most practical from an engineering standpoint is that afforded by the simple direct current potentiometer. In this well-known device, a constant potential is maintained across a slide-wire resistance, and the potential to be measured is applied in opposition to a portion of this through a galvanometer. If the two are not equal the galvanometer deflects, and ad-

justments of the point of application are made along the slide-wire either manually or automatically, until a balance exists. The actual measurement is derived from the physical position which the slider occupies in regard to the slide-wire resistance.

A suitable curve-drawing potentiometer is found in the recorder shown in Fig. 5, manufactured by the Leeds and Northrup Company of Philadelphia. This instrument is fairly simple and reasonably rugged, and, under intelligent care, gives very satisfactory performance. Its inherent accuracy is high, and its sensitivity may easily be kept within one-half of one per cent. of its ten-inch scale. This recorder is much used in pyrometry and temperature work, in general, and has found considerable application in other fields of technical activity. The instrument selected for the Toronto installation was arranged to have a full-scale deflection corresponding to 150,000 kilowatts on the system with a zero-suppressing switch to add 100,000 kilowatts to this range. In case it should at some future time become necessary to alter the range of the recorder, the design is such that this can be accomplished with little loss of time and at a trifling cost.

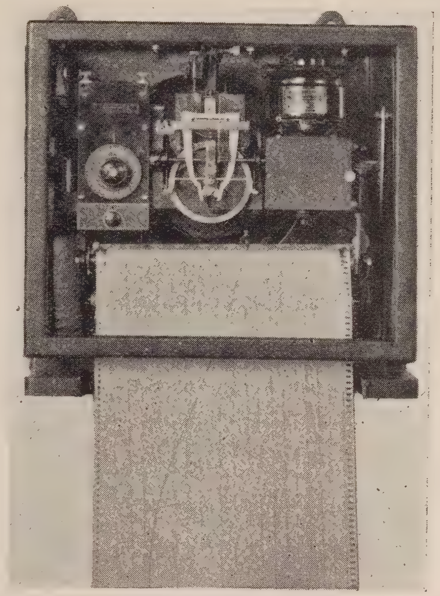


Fig. 5. Leeds and Northrup Recording Potentiometer.

The Toronto Installation.

The layout of the Toronto totalizing system calls for the summation of loads on four distinct transformer stations, and the "bucking off" from this total of the loads on several feeders not supplying the Toronto Hydro-Electric System. The general arrangement is shown in Fig. 6. In Strachan Avenue Station are six 110,000/13,200 volt transformer banks supplying the main low-tension busses, and two feeders to synchronous condensers used for power factor correction. Thermal converters are installed on the instrument transformer secondaries of the low tension side of each bank, while the two condenser feeders, through totalizing and ratio-adjusting double-primary current transformers, are metered on one converter. The three banks in Wiltshire Avenue Station are metered through individual converters. Bridgeman Avenue and Davenport Road Stations, while geographically adjacent, are operated as separate units, one being supplied at 110 k.v. from Queenston, and the other at 90 k.v. from the Electrical Development plant at Niagara Falls. Between

the low tension circuits of these stations are installed tie feeders, through which power may be flowing in either direction. As these lines are taken off close to the Bridgeman transformers, it becomes necessary to install converters on them as well as on the main feeders from the banks. From Davenport Station there are also several feeders supplying power to loads other than Toronto; and these are "bucked off" through totalizing current transformers operating a single converter. With the several converters in series, as shown in Fig. 6, it is evident that the total electromotive force set up within the loop is at all times proportional to the output of the transformer banks supplying the 13,200 volt busses, less such deductions as are not chargeable against the customer. The recording potentiometer installed in this circuit gives then a continuous graphic record of the power supplied by the Commission to the network of the Toronto Hydro-Electric System.

Performance of the System.

During the development of the system, which has occupied approximately two and a half years, numerous trials and tests were made of the operation of the constituent parts; and, with a borrowed recorder, charts were obtained of the power load of the Toronto Laboratories

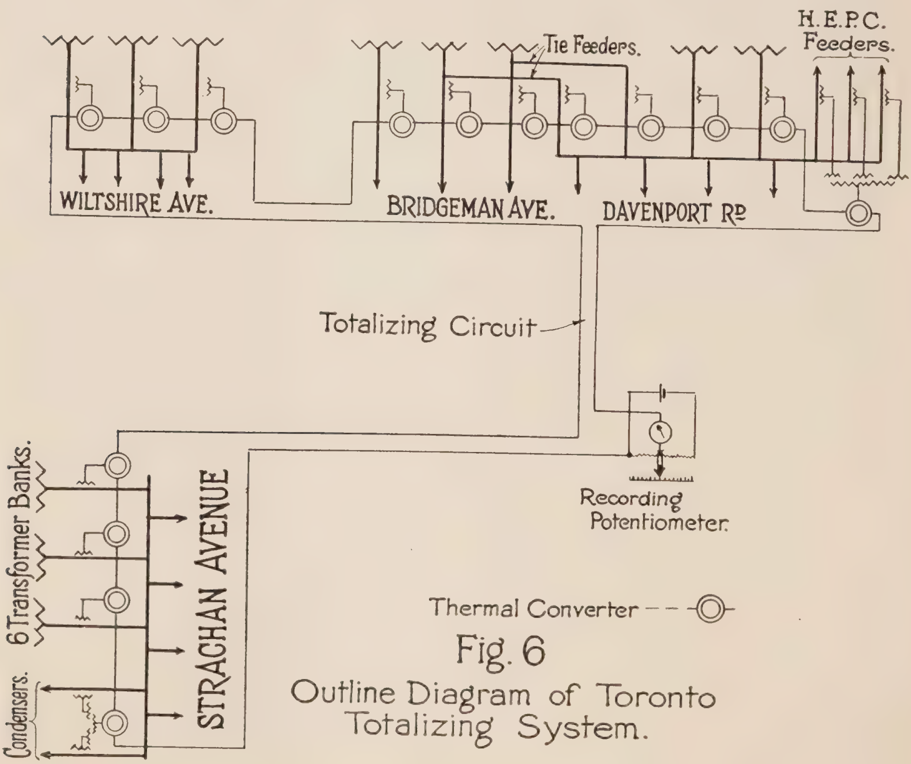


Fig. 6
Outline Diagram of Toronto Totalizing System.

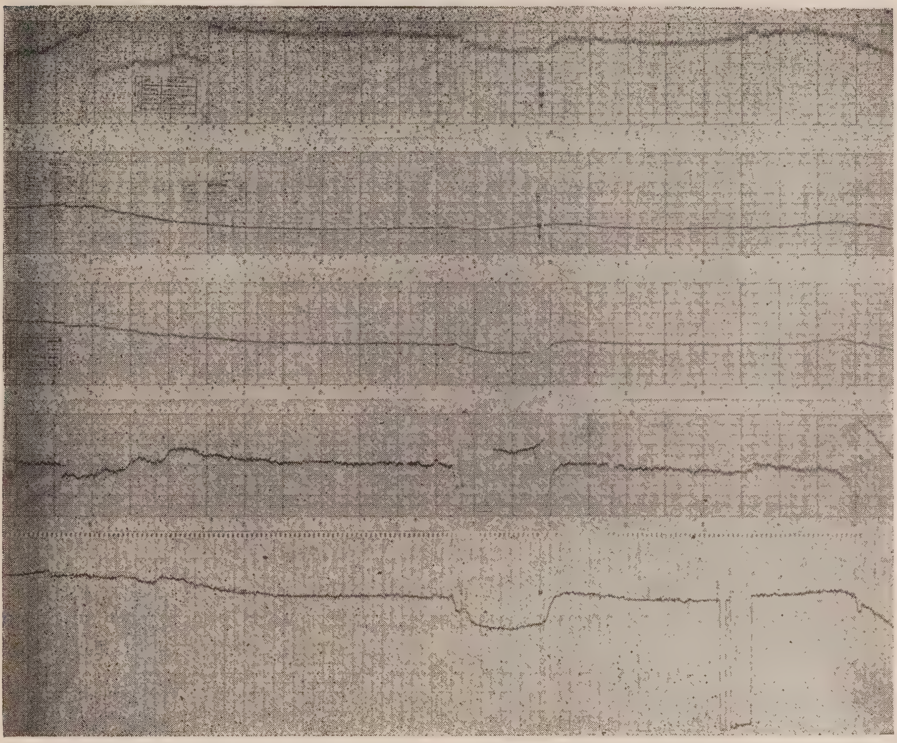


Fig. 7. Graphic Chart from four Toronto stations with Totalizer Chart below.

when the work was in a very early stage. The tests were gradually extended to include in the metering circuit various available loops of telephone cable; and, in the latter part of 1925, a portion of the Davenport Station load was recorded upon an instrument temporarily installed in the Commission's offices on University Avenue. A graphic chart of the total load of Strachan Avenue Substation was obtained at the Laboratories on August 3, 1926; and on September 13, the first totalization of the Toronto City load was accomplished. In Fig. 7 are shown a group of charts illustrating part of a day's record from the installation. The lower chart is the record from the totalizing instrument; and the four upper charts represent the loads upon the four stations included in the summation. (The sudden and extrême transitions are not, of course, actual load changes, but show zero tests and manipulations of the zero suppressors.) A very superficial inspection of these charts will suffice to show the advantage of having a summation of the four records when it becomes necessary to select and determine the peak for the day.

While, at the date of writing, the system has been in operation for but a short period of time, a number of outstanding advantages have already made themselves evi-

dent; and some of these may be enumerated as follows:

(1) *Freedom from moving parts in the transmitting elements.* The converters may be installed on the backs of panels, and in unattended stations, and in any position. All moving parts are concentrated in the recorder, which is under constant supervision of competent operators. Neither opening nor shorting the thermocouple circuit produces any damaging effect upon the converter.

(2) *Complete reversibility of converters.* The thermal converters maintain their linear characteristic irrespective of the magnitude or direction of the load; so that, should it become necessary to reverse the power flow in any feeder or group of feeders, the converters will automatically reverse their potentials, and without any attention whatsoever from the operators, deduct the outflowing power from the total.

(3) *Inherent flexibility of the method.* Should it become necessary to rearrange feeders or redistribute loads the totalization will still be accomplished with a minimum of changes in the converter circuits. When new stations are added to the system, it will only be necessary to place the converters associated with these stations in series with those already installed, when the total load will be registered on the recorder. In case of damage to a converter, its replacement by a new unit is a matter of minutes, and no adjustments are required after installation.

(4) *Immunity to resistance changes in the interconnecting circuit.* The resistance of the totalizing circuit has no direct influence upon the accuracy of the results. The only effect produced by resistance changes is seen in a slight alteration in the sensitivity of the recorder. Variations of the order of 100 per cent. in the resistance of the circuit, introduce barely perceptible changes in the characteristic of the recorder chart.

(5) *High inherent accuracy.* Before installation each converter was calibrated to a long-scale standard wattmeter and laboratory potentiometer; and repeated checks and adjustments were made on the recorder. Service checks include similar tests with portable standard instruments. The absence of moving parts in the converters and the natural precision of the potentiometer method of measurement make for great accuracy in the over-all determination; and it would appear that the limiting feature of accuracy lies in the recording mechanism, which, as stated above, can be depended upon to a precision of one-half of one per cent. of the full scale of the instrument.

The Fourth Article on

Application of Hydro-Electric Power to Farm Work

will Appear in the November Number

Toronto to Cameron Falls by Radio

SHORT wave radio now links the Toronto offices of the Commission with the generating station at Cameron Falls, and with other parts of the Thunder Bay System.

During the winter months the engineers of the laboratories, with the cooperation of several Canadian members of the American Radio Relay League, investigated the possibilities of communicating directly between Cameron Falls and Toronto by means of short radio waves. These tests showed the proposition to be quite feasible and the Commission then authorized the construction of the two radio stations.

The transmitting and receiving equipment for these installations was designed by the Commission's engineers and built at the laboratories.

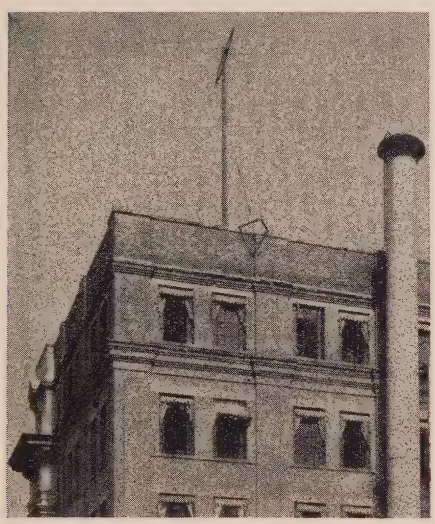


Fig. 1. Radio station at Toronto. (Aerial pole on roof of office building.)

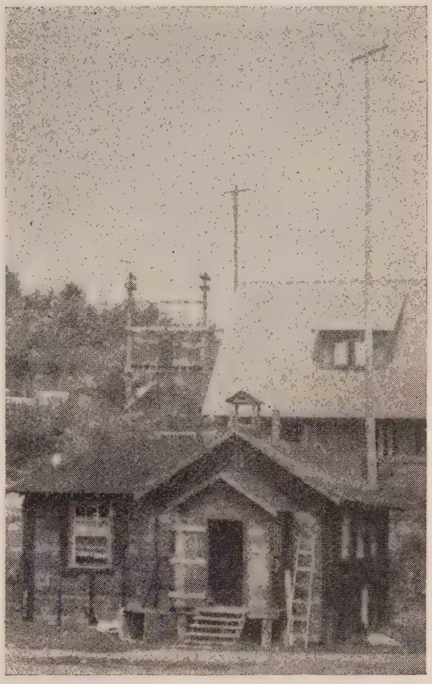


Fig. 2. Radio station at Cameron Falls in School building. (Aerial pole in rear of Building.)

The Toronto station, ("9AI") is installed on the sixth floor of the Administration Building, 190 University Avenue, with aerial mast on the roof, Fig. 1, and the station at Cameron Falls, ("9AQ") is in operation temporarily in a small school house building on the west side of the Nipigon river, Fig. 2.

The Department of Marine and Fisheries has granted the use of two wave lengths,—29.94 metres for daylight and 50.0 metres for night transmission,—and the sets are operating under experimental licenses at present.

Messages are sent by code only and loud clear signals are received

in either direction. A very considerable saving in time is effected by the use of the radio equipment as messages are received at their destination three or four days earlier than by the usual mails.

THE TRANSMITTERS.

The transmitting equipment is mounted on the rear of an upright hardwood frame, the panels of which have been boiled in paraffin to improve their insulating properties, thus forming a material which is recognized as superior to the usual materials supplied for radio frequency insulation.

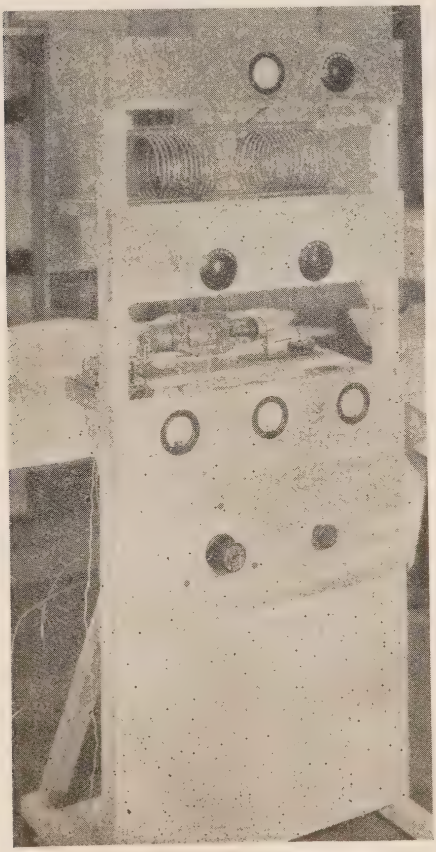


Fig. 3. Short wave Radio Transmitter. (Front view.)

In Figs. 3 and 4 are shown respectively the front and rear views of one of the transmitters. The power tube, type UV-204-A, having an output rating of 250 watts, is mounted on a horizontal panel. Above the tube are the inductances and condensers, forming the radio frequency circuits, and below are the filters and control equipment.

The inductances are supported by horizontal glass bars and are placed in such positions that their magnetic fields are not influenced by the metal parts of the equipment. The condensers are mounted on one of the front panels, and their shafts, as well as those of the rheostats and the cases of the instruments, are at ground potential, thus removing the possibility of electrical shock or high frequency burn in operation.

The design of the transmitter also is such that the tube and inductance coils may be seen from the front, enabling the operator to observe the condition of the tube and all adjustments in the circuits from his position at the receiving table.

These transmitters are started and stopped, and also keyed, by remote control through low voltage circuits.

At the Toronto station, the power supply is from the 220 volt, 3 phase, 25 cycle, elevator circuit to a one horsepower motor which drives two direct current generators by belt. The smaller of these generators supplies current to the filament of the tube while the larger generator is excited from the smaller one and supplies the plate power at 2000 volts.

At Cameron Falls, however, the filament of the tube is lighted by alternating current through a specially designed transformer. The plate power at 2000 volts is obtained from a small direct current generator directly coupled to a 550 volt 3 phase induction motor.

On account of the difference in filament supply, there is a slight difference in the design of filtering and control equipment at the two stations.

The Keying System.

In addition to the tube, oscillation circuits and power supply, it is necessary to provide means for varying some property of the radiated waves in order that these radiations may be used for transmission of messages. There are several methods of accomplishing this but the majority of them have serious disadvantages, either in causing wide variation in the power in the plate circuit, and thus an uneven load on the generator, or in interfering with broadcast receivers due to a bad clicking while keying. Also some of these systems will not allow of the condenser shafts being grounded, which not only places the operator at a certain risk while handling the dials but also introduces body capacity effects, rendering tuning very difficult.

The keying system for these transmitters, therefore, was specially designed to meet all requirements, avoiding as far as possible the objectionable features of the other systems. The method used employs a small adjustable condenser, which is connected in parallel with the main grid-tuning variable condenser whenever the key is pressed. This causes a slight variation in the wave length of the radiated waves, the longer wave being the true wave, and the shorter one being the spacing wave. The receiving operator then tunes to the true wave and does not hear the spacing wave at all.

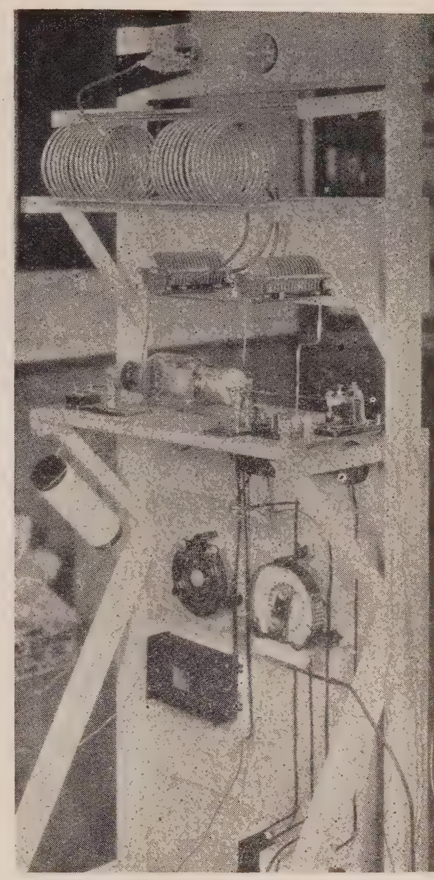


Fig. 4. Short wave Radio Transmitter. (Rear view.)

The additional parts which comprise the keying system are shown in Fig. 5. The adjustable condenser is in the foreground with a relay at

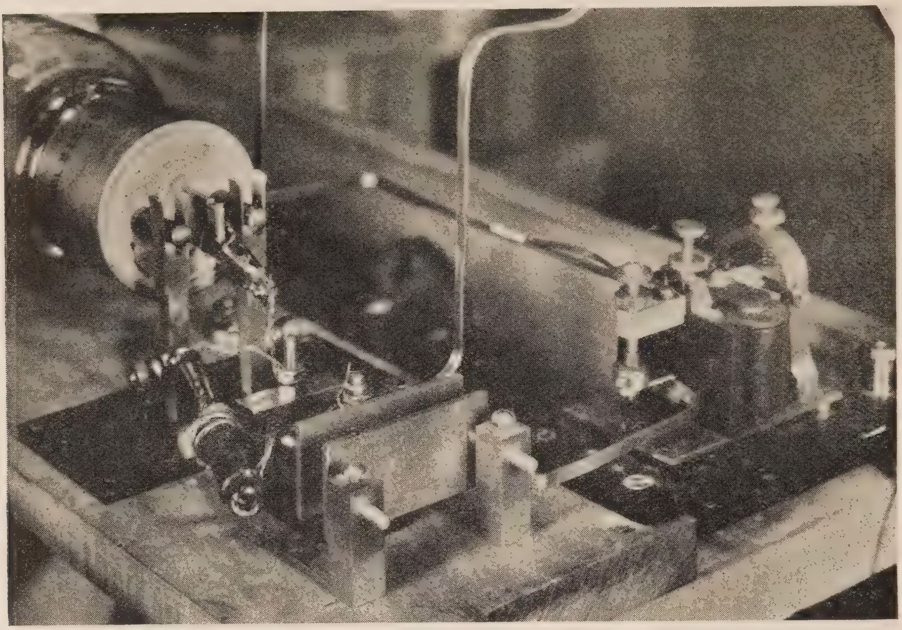


Fig. 5. Keying System—Short wave Radio Transmitter.

the right. This relay is controlled directly by a small telegraph key and is used in preference to placing the key itself in the high frequency circuits.

As the oscillations of the tube are not interrupted in keying, but only a slight change is made in wave length, the plate current remains practically constant and therefore the load on the generator is equally steady. The aerial current also does not vary as the change in wave length is so small and this feature prevents interference with broadcast listeners, during transmission. The relay, allowing of remote keying, avoids both the risk to the operator and all body capacity effects.

The keying condenser and relay are mounted near the base of the tube in order that all connections may be as short as possible, but the key is placed on the receiving table in a convenient position.

The Receivers.

For reception of short waves a regenerative receiver is necessary and it is usual to have only one stage of audio amplification.

The type of receiver used in these two stations is shown in Fig. 6 and 7. On the panel there are only the vernier dials for two variable condensers and the filament switch. The principal tuning condenser has only three movable and two stationary plates and the inductances have very few turns.

All of the parts are widely spaced and the best insulating materials have been chosen. Two type U-V-

201-A tubes are used, one as detector and the other as amplifier.

THE ANTENNA SYSTEM.

For short wave operation, the transmitting aerial requires to be quite small. At each of these stations it consists only of a single solid copper wire, about 35 ft. in length, placed vertically or nearly so, with a wire cage at the top. The construction of the aerial at Toronto is shown in Fig. 8, whereas the aerial mast at Cameron Falls appears in Fig. 2, just at the rear right hand corner of the small building in which the equipment is installed.

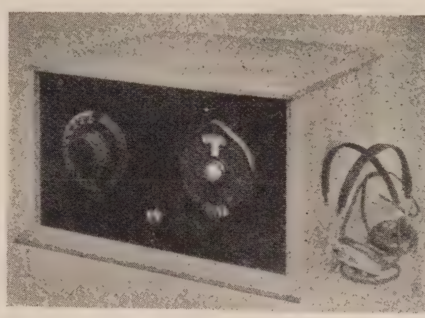


Fig. 6. Short wave Radio Receiver. (Front view.)

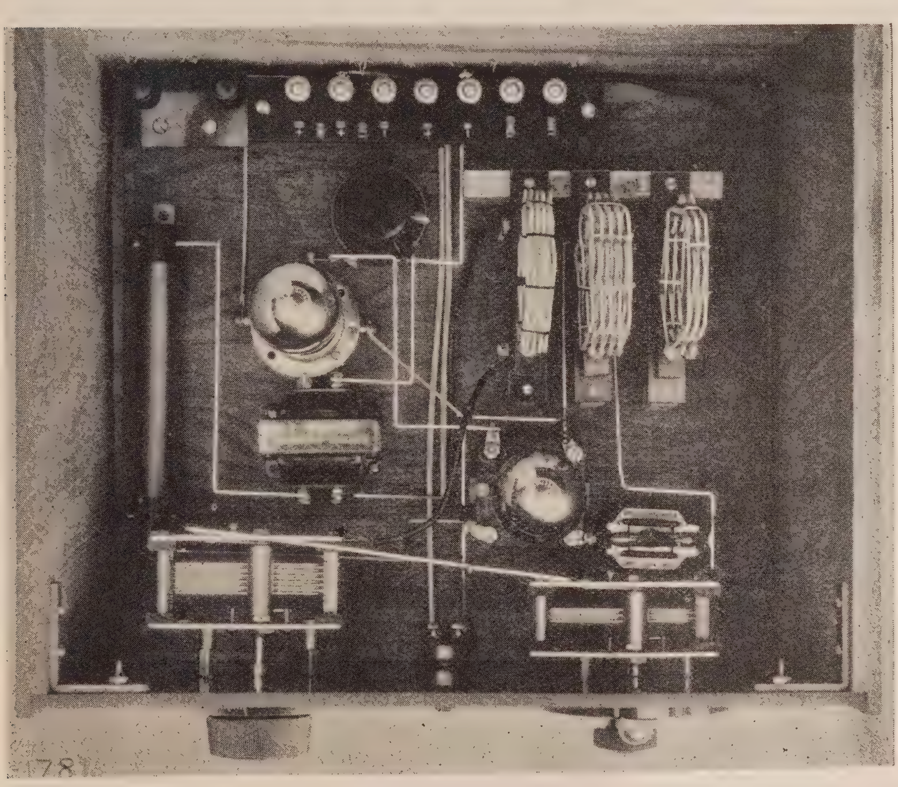


Fig. 7. Short wave Radio Receiver (Top view—cover open.)

Fig. 8. Aerial construction at Toronto.

Fig. 9. Lead in construction with Pyrex Insulators.

Pyrex glass is used throughout for insulation of the aerials, this material having excellent insulating properties and also being quite light in weight. The types of strain and post insulators and of lead-in bushing, also the arrangement of the lead-in wire, may be seen in Fig. 9.

Instead of ground connections, the transmitter operates on a counterpoise. This consists of a single solid wire a little longer than the aerial and relatively nearer to the ground, but well insulated from both aerial and ground.

For reception, a single wire aerial and ground connection are used. In dimensions this aerial is about the same as is usually erected for broadcast reception.

Operation.

The stations work with each other on prearranged schedules, calling in the usual way, and handling messages relating to operation of the power system, to additional construction, or to the electrical affairs of the municipalities on this system, but are not used for regular public commercial service.

All messages for municipalities on the Thunder Bay System are relayed from the radio station at Cameron Falls over the Commission's private telephone lines.

A recent number of *The Electrical Review* contains the following item concerning rate reductions at points in the British Isles:

"Reductions in the charges for electricity have been made or recommended in the following districts:—

Gloucester—Lighting: First 500 kwh. per quarter, 6d. per kwh.; next 1,000 kwh, 5d.; next 8,500 kwh. 4d., beyond, 2d.

Dublin—Lighting: A reduction of 1d. per kwh.

Kingston (Co. Dublin)—Lighting: From 10d. to 8d. per kwh.

Chesterfield—The basic charge to large power consumers of £6 per kva. of maximum demand and .4d. per kwh, reduced to £5 10s. and .375d. respectively, with the existing discounts.

Maidenhead—Lighting: From 6½d. to 6d. per kwh. Power and heating: From 2d. to 1¾d. per kwh."

It also contains note regarding an inquiry held in June into an application of the Urban District Council of Armagh, Ireland, for sanction to a loan in connection with a proposed electricity scheme. It is stated that:

"The charges would be 9d. per kwh. for private lighting, 4d. per kwh. for power and 3d. for public lighting."

Users in Ontario cannot but consider themselves fortunate, for were they required to pay for their electric service at rates as quoted above, many of them would, of necessity, have to forego the conveniences they now enjoy and limit their uses to lighting only.

HYDRO NEWS ITEMS

Central Ontario System

The Commission is preparing a report on the development of a local water power site to provide improved electric power service in the municipality of Bancroft.

* * * *

4.5 miles of line are being constructed in the Oshawa Rural Power District to serve consumers north of the village of Brooklin.

* * * *

A survey for the establishment of a rural power district in the north end of Rawdon township is being made.

* * * *

The local feeder circuits from Bowmanville station are being reconstructed to provide for improved service.

* * * *

Rural districts are being established at Napanee and Lindsay to provide for service to consumers located near the municipal boundaries.

* * * *

Niagara System

A new outdoor type substation of 300 kv-a. capacity has recently been erected at Jordan Station to take care of the rapidly increasing load in the Beamsville Rural Power District. A line is about to be built to serve Wellandport and the Village of St. Ann's and district, a distance of approximately thirteen miles.

* * * * *

A new type outdoor station has been constructed at Riverside to serve power to that Municipality and also to Tecumseh and St. Clair Beach. This Station consists of 1-1500 kv-a. three phase outdoor unit, Station being provided for additional units of similar size.

* * * *

Construction work is under way to give service to St. Williams and Port Rowan districts, and service will be given to the Ontario Government Reforestation Station located at St. Williams, which is one of the largest, if not the largest of its kind in the world.

* * * *

A second transformer bank is being installed at Hespeler consisting of 3-100 kv-a. transformers. The present bank of 3-75 kv-a. transformers in the Hespeler Station is being replaced by 3-150 kv-a. This change is made necessary by the rapidly increasing rural load in the district.

* * * *

A new outdoor type Station has been erected at Dashwood consisting of 3-75 kv-a. outdoor type transformers. This Station will serve Zurich, Dashwood and the adjacent

Rural Power District including the Police Village of Grand Bend.

* * * *

There has been considerable activity in connection with the Rural Power Districts in the Niagara System during the year, and it is estimated that the year's construction will amount to approximately 670 miles, with a capital expenditure for primary and secondary of approximately $1,352,765.00.

* * * *

The Police Village of Cottam recently passed Hydro by-laws to take power direct from the Commission and operate its own distribution system.

* * * *

Rural Power District offices have recently been opened up at Essex, Kingsville and Amherstburg to take care of the rapidly increasing business in the Rural Power Districts adjacent to those centres.

* * * *

A Rural Power District office has recently been arranged for at Aylmer to take care of the Aylmer Rural Power District, which includes an eighteen mile line extension to Port Burwell. The transmission voltage in this district will be 8000 volts.

* * * *

St. Lawence System

A transmission line is under construction to supply rural service to residents of Monkland and Avonmore in the Apple Hill Rural Power District.

* * * *

The residents of Embrun are receiving rural service in the Chesterville Rural Power District.

September 30th marked another happy addition to the Hydro family when a daughter arrived in the home of Mr. R. T. Jeffery, Municipal Engineer, and Mrs. Jeffery. Congratulations.

We are pleased to note that Mr. J. H. Caster, Assistant Engineer, Municipal Department, who has been seriously ill for about a month past, is now on the way to recovery, and the hope is expressed for his early return to good health.

Mr. J. M. Duncan, who was Mechanical Engineer, Mechanical Section, Electrical Engineering Department, on steam plant studies, together with Mr. L. L. Youell, who was associated with him, have left the Commission and are now on the engineering staff of the Atmospheric Nitrogen Corporation, Syracuse, N.Y. To both are extended best wishes for success in their new endeavours.

Another employee of the Commission entered the ranks of benedicts when Mr. Benjamin Pyburn of the Municipal Audit Department took as his bride, Miss Margaret Workman, daughter of Mrs. A. Workman and the late Mr. A. Workman, of Coleraine, Ulster. The ceremony was performed at Kew Beach Presbyterian Church, Toronto, on Tuesday October 5th. To Mr. and Mrs. Pyburn are extended every good wish for the future.

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in September, 1926.

Appliances

ALLOVER MFG. CO., 1127 Irving Place, Racine, Wis.

"Allover" Hair Clippers, magnetically-operated.

* * * * *

BRA-MAC ELECTRIC MFG. CO. LIMITED, 20 Millstone Lane, Toronto, Ont.

Electric Floor Polisher. "Bra-Mac Electric Mfg. Co. Ltd."

* * * *

CANADIAN RADIANT ELECTRIC COMPANY, Grimsby, Ont.

"Radiant" low type, single-burner and two-burner hotplates.

* * * *

CANADIAN GENERAL ELECTRIC CO. LTD., Peterborough, Ont.

"Tungar" Rectifiers, Small size, portable, Form B, Cat. Nos. 277163, 279172, 219866, 260351; Large size, stationary, Form A, Cat. Nos. 179492, 199545.

* * * *

CORNISH & ROUNDING, 20 Ferry St., Windsor, Ont.

Electric Signs.

* * * *

C. A. DUNHAM COMPANY, LIMITED, 1523 Davenport Rd., Toronto.

Automatic Pumping Outfits.

* * * *

FINDLAY BROS. CO. LIMITED, Carleton Place, Ont.

"Findlay," One, two and three-burner hotplates, Style Nos. E1, E2, E3, S1, S2, S3, 30S, 30E, S20L, E20L.

Ranges, Cabinet type, Style Nos. CRAS, CLAS, CRAE, CLAE, C24S, L24S, C24E, L24E; Low oven type, Style Nos. UA3S, UA4S, UA3E, US4E, UB3S, UB4S, UB3E, UB4E.

* * * *

THE FITZGERALD MANUFACTURING CO., Torrington, Conn.

Electric Hair Dryer, Junior Size. "Star-Rite" Portable Vibrator.

* * * *

E. J. GROVES, Parry Sound, Ont. Electric Soldering Iron.

* * * *

KELVINATOR OF CANADA, LIMITED, 1152 Dundas Street East, London, Ont.

Electric Ice Cream Cabinet. "The Nizer Corporation."

* * * *

J. W. MADIGIN, 105 Colbeck St., Toronto, Ont.

"Vulcan" Rectifier, stationary type.

* * * *

H. G. MCFADDIN & CO., 38 Warren St., New York, N.Y.

Therapeutic Lamp. "Thermo-lite" Heat & Light Applicator.

* * * *

GEO. C. MCINTOSH, 684 Marquette Drive, Detroit, Mich.

Portable Air Heater, Radiator type, Steam Heated.

* * * *

THE METAL STAMPING & MFG. CO. 16816 Waterloo Rd., Cleveland, Ohio.

Picture Machine—Stereopticon type. "Mirroscope".

* * * *

The National Electric Heating Co. Limited, 544 Queen St. E., Toronto, Ont.

"National, portable one and two-burner hotplates. Cat. Nos. 350, 360.

* * * *

Provost & Provost, 2564 St. Hubert St., Montreal, Que.

"Modern" Immersion type water heater.

* * * *

Reed and Cameron, 188 Adelaide St. W., Toronto.

Toaster stove, round type. "Reed and Cameron."

* * * *

Webb & Halliday (Submittor), 1 Teraulay St., Toronto, Ont.

The Bow Company (Mfr.), 22 Victoria St., Montreal, Que.

"Bo-Plex" electric sign, Flasher-operated type.

* * * *

Whittaker Fireplaces, Windsor, Ont.

Open Hearth Grate, Stationary type, Cat. No. 39.

* * * *

The D. H. Williams Co. (Submittor), 302 Ridout St. S., London, Ont.

National Machine & Tool Co. (Mfr.), 801 South Water St., Jackson, Mich.

Electric Tube Vulcanizer, Types M-72 and M-88.

* * * *

*Air Conditioning & Engineering Co. The, 2914 S. Jefferson St., St. Louis, Mo.

Ozonator Equipment. Series B, F, G, H, Types W9, X6, Y9, Z3 and Z6.

Marking: Nameplate with rating, trade name "Electrozone" with manufacturer's and address.

* * * * *

*Honeywell Heating Specialties Co. The, Wabash, Ind.

Honeywell "Type A" Boiler Control—for Oil Burners.

Marking: "Type A" on indicating scale of instrument.

* * * *

*Jefferson Electric Mfg. Co., 501-511 S. Green St., Chicago, Ill.

Toy Transformers "Little Jeff", "Midget".

Marking: Nameplate with type and rating.

Power Transformers, Core type, step-up ignition.

Insulated secondary type, Cat. Nos. 101-12, 101-16, 101-22, 101-26, 103-12, 103-16, 103-22. Grounded secondary type, Cat. Nos. 100-12, 100-16, 100-22, 100-27, 102-12, 102-16, 102-22, 102-26, 104-12, 104-16, 104-22, 104-26.

Marking: Manufacturer's name, address, catalogue number and rating of device on nameplate.

Air-cooled transformers (As listed on Underwriters' Laboratories card dated December 29, 1925).

* * * *

*Robeson-Rochester Corporation, 176 Anderson Ave., Rochester, N.Y.

Electric Percolator. Cat. Nos. E137, E153, E155, E157, E159, E227, E247, E257, E346, E419, E478, E489, E545, E547, E548, E549, E557, E589, E599, E610, E619, E678, E680, E687, E689.

Marking: Manufacturer's name and catalogue number.

*STERLING MFG. CO. THE, 2831-53 Prospect Ave., Cleveland, Ohio.

Vacuum Tube Reactivator. Cat. No. R-403.

Marking: Manufacturer's name-plate with rating.

* * * *

Fittings

DOMINION MACHINE AND TOOL CO. LTD., 460 Richmond St. West, Toronto, Ont.

Sheet Steel Outlet Boxes.

Sheet Steel Covers for Outlet Boxes and conduit fittings.

* * * *

THE NATIONAL ELECTRIC PORCELAIN CO., Carey, Ohio.

"Nat-Ready" split knobs.

"N" porcelain tubes.

* * * *

SMITH & STONE LIMITED (Submittor), Georgetown, Ont.

Conduit Boxes, cast iron, Series G.H.J.K.

Cast iron service entrance fitting, Type FE.

Marking: S-S cast on boxes.

* * * *

Switches

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, 224 Wallace Ave., Toronto, Ont.

Enclosed Switches, motor-starting, Types CR. 1038A1.

* * * *

DOMINION ELECTRIC MANUFACTURING COMPANY, LIMITED, 60 Sumach St., Toronto, Ont.

Motor-starting, double-throw knife switches, Cat. Nos. 66351, 66341. Quick-make and break mechanism, Cat. Nos. 80251, 86252-86256 incl. 80351, 86352-86356 incl. 86451-86455 incl. 86341-86346 incl. 86441-86445 incl.

* * * *

ELECTRICAL DEVICES LIMITED, 20 Hayter Street, Toronto, Ont.

Service Entrance Switches. With solid neutral, Cat. Nos. 312A, 312B, 431-438 incl. Standardized meter service switches, Cat. Nos. 100-103 incl., 105-108 incl., 104. Without solid neutral, Cat. No. 312.

Switches with quick-break mechanism. Fused, Cat. Nos. 531-36 incl., 541-45 incl., 621-25 incl., 631-35 incl., 421-28 incl., 884-91 incl., 441-45 incl. Unfused, Cat. Nos. 1122-28 incl., 1132-38 incl., 1162-65 incl., 1232-35 incl.,

* * * *

NORTHWESTERN ELECTRIC COMPANY, 408-16 South Hoyne Ave., Chicago, Ill.

Auto Transformer Starter and Controller.

* * * *

*SEPCO AUTOMATIC HEATERS LIMITED (Submittor), 39 Richmond St. East, Toronto, Ont.

AUTOMATIC ELECTRIC HEATER CO. (Mfr.), Cross and Keim Sts., Pottstown, Pa.

Temperature Regulating Appliances, Types P, R, T.

Marking: "Sepco" with rating, type and manufacturer's name.

* * * *

Portable Lighting Devices

ALADDIN MANUFACTURING CO., Muncie, Indiana.

Portable Electric Lamps. "Aladdin."

* * * *

H. G. McFADDIN & Co., 38 Warren St., New York, N.Y.

Portable Electric Lamps. "H. G. McFaddin & Co., New York."

* * * *

THE STANDARD BRONZE Co. LIMITED, 4 Trafalgar Avenue, Toronto, Ont.

Portable Electric Lamps, Picture Light Reflectors and Dress Lights.

* * * *

Miscellaneous

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, 224 Wallace Avenue, Toronto.

Time Limit Protective Cutouts, Type CR. 1920. Cat. Nos. 256921, 256925, 256928, 256932.

* * * *

CANADIAN RADIANT ELECTRIC Company, Grimsby, Ont.

Heater Cord Sets.

* * * *

CITY BATTERY SERVICE, 301 Coleman St., Belleville, Ont.

Armature Tester.

* * * *

*ERICSON MANUFACTURING Co., 1987 East 105th St., Cleveland, Ohio.

Socket Guard.

Marking: "C. & E." and manufacturer's name.

* * * *

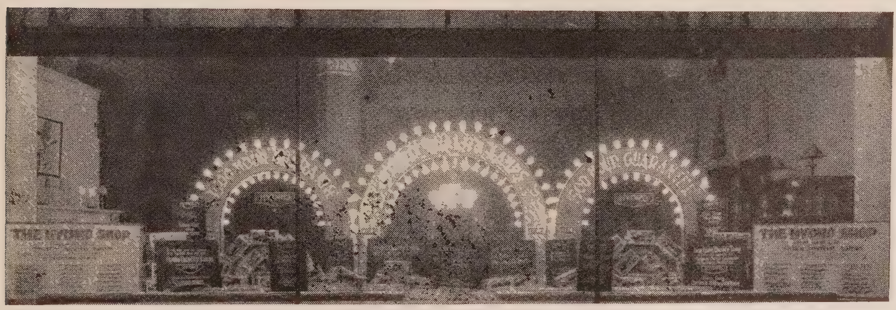
*ROME WIRE Co., Rome, N.Y.

"Romex" non-metallic sheathed cable.

Marking: One yellow and one green thread woven together in the braid on the individual conductors.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.



Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

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HYDRO-ELECTRIC POWER COMMISSION
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Health Service in Construction Camps

IN carrying out the various construction works of the Commission, a particular endeavour has always been made to see that the health of the employees on the work is safe-guarded. Due to the different sizes of the jobs, it is impossible to use the same type of service in each case but an endeavour has been made to develop a Health Service that is satisfactory and successful for the particular work in question.

During the construction of the Chippawa-Queenston Power Development, due to the great number of men employed on this work, it was necessary to have quite an extensive Medical Service and although possibly the matter of attending to the injured worker might have been more apparent than other work, the provisions made to safeguard the health of the worker on this Development were quite extensive. Quite naturally, drinking water supplied to any community should be safeguarded and a continual check of the sources of the drinking water for the Chippawa-Queenston Development was carried out, samples being taken and sent to the Provincial Laboratories for test and records carefully checked. The result of this endeavour was, that although this district of Ontario is known to have a fairly high typhoid rate, there was not a case of typhoid among any of the workers on this Development.

Even although the living conditions at Queenston Power Development were, at times very crowded, yet by a careful and efficient method of quarantine put into effect, there was no outbreak of an extensive character in connection with sickness in the camps. During the influenza epidemic, there was far less influenza per capita among the men resident in the camps at Queen-

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ston than in the adjacent city of Niagara Falls.

A close check was also kept on the various kitchens, dining-rooms and sleeping quarters and health provisions put into effect to make the camps as healthy as possible; the general result being that there was very little sickness among the workers and in the cases of sickness, immediate attention was given to the workers resident in the various camps of the Commission by Medical Officers giving their whole time to the work.

A fully equipped emergency and convalescent hospital was established on the work, having 44 beds, service being rendered to injured and sick employees in a manner somewhat similar to that carried on by a Military Hospital.

During the work of the development at Cameron Falls on the Nipigon river, a complete Medical Service for injured and sick employees was carried out, there being a resident Doctor and assistants on duty at all times. It was decided that it would not be of the greatest advantage to install a complete hospital at this point and it was decided to have a Dressing Station with a few hospital beds which could be of use in an emergency, the severely injured person or the seriously ill person being transported with an attendent to the Hospital in Port Arthur or Fort William. As at the Queenston work, the drinking water supply, kitchen, dining-room and bunk houses were carefully checked and investigated from time to time by the Medical Service.

At the peak of the work a severe influenza epidemic broke out, one of the bunk houses being turned into an emergency hospital and nurses supplied from outside. The type of attention given during this outbreak of influenza was of such a character, that although a number of cases of pneumonia developed from the influenza, there resulted only one fatal case and this case developed into a fatality after the crises of pneumonia had passed, the employee having a very weak heart, having been refused Overseas Military Service on account of his heart condition. Later on, a case of smallpox developed in the camp and such complete quarantine was established that the employee recovered perfectly and no other cases of smallpox developed in the camp, this case of smallpox having been

brought in from an outside point.

Virgin Falls Development was carried out as a branch of the Cameron Falls Development and is an example of a different type of Medical Service. The Medical Officer stationed at Cameron Falls, made regular trips to Virgin Falls carrying out the medical supervision, there being resident at Virgin Falls an exceptionally well trained First Aid man who gave part of his duties to First Aid and carrying out the instructions of the Medical Officer in regard to the health of the camp, as well as carrying out certain clerical duties in connection with stores. This method of carrying out Medical Service in smaller construction camps has been used on a number of occasions and has much to recommend it.

In the smaller camps such as line gangs, fully equipped First Aid outfits with the necessary instructions have been supplied to all line gangs. These First Aid Kits deal not only with the attention to injuries, but also look after a certain type of ailment such as colds, etc. These have been particularly carefully designed and the instructions have been worked out after some years of experience in the work.

The line gangs are also required to from time to time send samples of drinking water to the Provincial Laborities for analysis. Reports of these analysis being sent to Head Office. The gangs are also equipped with portable convenient water testing and chlorinating outfits so that they can be always sure of a supply of pure drinking water. Both of these places have worked out satisfactorily.

All of the Medical Service is closely tied into the Head Office in Toronto where a close supervision is kept of the working out of the service; all injuries and sickness being closely followed up; all the reports of Doctors and others in immediate attendance on the cases being checked by consultants in Toronto. An endeavour has been made to work out a practical and efficient method of:

1. Safeguarding and improving the health of the employees on construction work, and
2. To render all possible service in combating any injury or disease that develops.

From time to time, educational matter in the shape of Bulletins or pamphlets are sent out into the field.

At the present time with the opening up of the Alexander Power Development, a Medical Service is organized to take care of this work using for the most part the Plant and equipment at the Cameron Falls Development. This service will no doubt follow very much along the line as that laid down and successfully carried out in connection with the Development at Cameron Falls.

It stands without question that a healthy employee renders better service than a sick one and it is in the interest of the employee, the Commission and the public that a thorough-going Health Service be carried out in construction camps.

Application of Hydro-Electric Power to Farm Work

Article No. 4.

THIS article gives the details of the installation and uses on the farm of Mr. Adam Cressman which is located in the Preston Rural Power District. Service was connected to this farm at the time the large extension was made in this district, in January, 1924, and is given under Class 4.

The uses to which the hydro-electric service is applied on this farm, are:—

In the house—lighting, a washing machine and electric iron.

In the barn—for a ½ horsepower motor which drives a milking machine or the emery-stone which is shown in Fig. 1, or the root pulper which is located in the root cellar to the left of the line shafting, and not in the picture, the loose belt of which is just beyond the main drive pulley, and for a 5 horsepower motor shown in Fig. 2 and used for chopping grain and cutting feed.

Before the Hydro lines were extended into this section of the township, Mr. Cressman was using a tractor for the work now done by the 5 horsepower motor, and was in doubt as to whether an electric motor this size would have sufficient power for this work. Using the equipment available, up to the time of taking this record, he had done all his chopping of grain and feed cutting with the motor, including cutting of about 50 loads of corn, of which he had more than he could put in his silo. This was cut by using his Blizzard No. 3 box running at a speed of about 300 rev. per min.,

Fig. 1. ½ h.p. motor suppying power to milking machine, emery stone and root pulper.

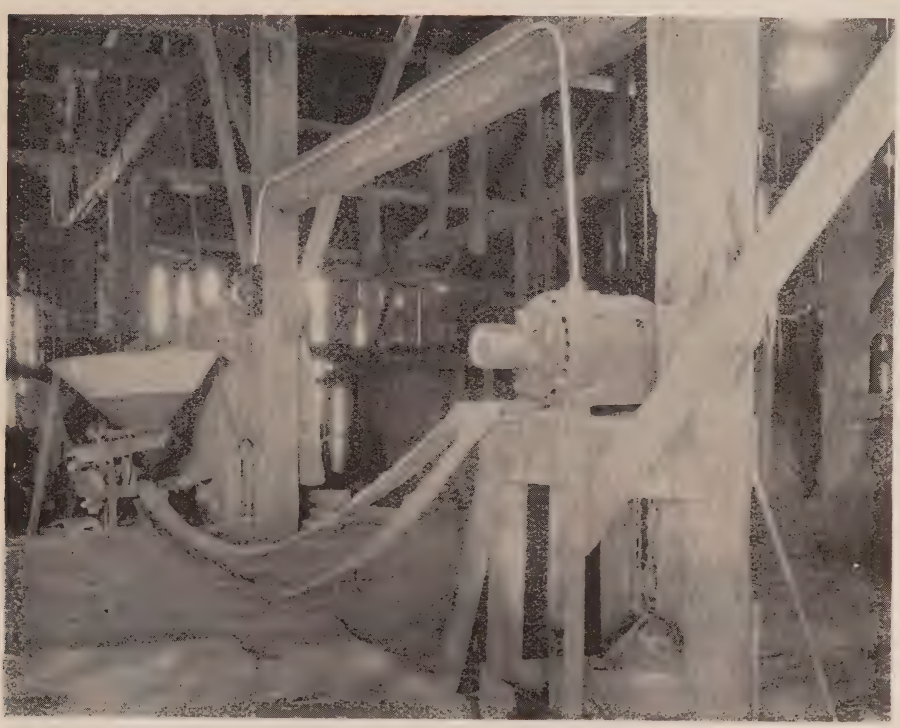


Fig. 2. 5 h.p. motor driving chopper and cutting box.

Fig. 3. Home of Mr. Adam Cressman and family.

a load or two being put through when needed, and blown across to the feed chute to the stable, the riser pipe on the box being an elbow and the distance across to the chute about 15 feet. The tractor has been superseded, as far as winter work is concerned, by this motor.

The water service on this farm is supplied from a small dam on the creek, a hydraulic ram being used for that purpose, with a storage tank in the barn. The water supply for the house is from a well close to it and for the present, is by the old-fashioned method of "Go out and get it."

Fig. 3 shows Mr., Mrs. and Miss Cressman in front of their house, a comfortable, old-fashioned home with a bell on the roof to call you to meals.

The installation on this farm consists of—

Lighting	1500	Watts
Washing Machine	186	"
Iron	600	"
½ h.p. Motor	373	"
5 h.p. Motor	3730	"
Total	6389	"

The nett cost and consumption for the year ending April 30th, 1926, was as in the tabulation shown below. 336 kilowatt hours of the above consumption was at the second rate.

The rate in this district for Class 4 is $4.30 per month.

4c. per kw. hr. for the first 70 kw. hr. in each month.

2c. per kw. hr. for the balance.

Less 10 per cent. on the whole bill.

CONSUMPTION AND NET COST FOR ONE YEAR

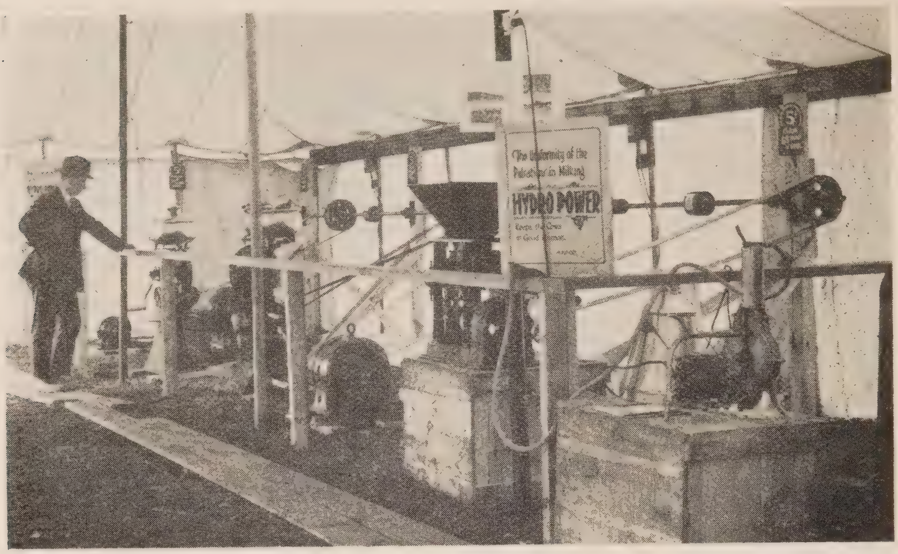
Quarter ending July 31st	171	kw.-hrs.—Costing	$17.77
" " October 31st	200	" "	18.81
" " December 31st	510	" "	24.57
" " April 30th	368	" "	22.01
Total	1,249		$83.16

Demonstration at International Ploughing Match

A DEMONSTRATION was again made this year at the Plowing Match which was held at Niagara Falls, Ont., on the 12th, 13th, 14th and 15th of October. The Match this year took the nature of an international contest, being held near the boundary line.

The attendance at these contests has grown largely. Ten years ago, a few thousand seemed to be a large attendance. Within the last five years, the attendance under favorable conditions, runs to very large numbers. It is estimated this year that there were between seventy and seventy-five thousand in attendance and the weather conditions were bad, the largest attendance for one day being estimated at forty thousand.

A corner in tent No. 1. showing demonstration of small household appliances and water pumping system. With each appliance was a sign showing the length of time it could be used at a total cost of 5c. with a 5c. rate.



Demonstration in tent no. 2. showing adaptation of power drive for barn and dairy.

The Commission made a demonstration consisting of the set-up which has been usual for this purpose under temporary conditions, two large marquee tents being used. In tent No. 1 the equipment consisted of stoves, washing machines, water heaters and appliances which might be used in the home, many of these being in operation. In tent No. 2, the set-up consisted of the application of a motor drive to a line shaft which might be adapted to a power drive for barn and dairy where the dairy is located in the barn.

A novel feature which has been used at several of these outdoor demonstrations, was an induced draught applied to two stoves, with

Some of the demonstration tents

a six inch underground duct as a flue, using a Canadian Forge and Blower Company exhauster blower. This installation drew a great deal of attention, as most of the visitors wondered where the smoke went.

The Commission arranged for an automatic water system of ten gallons per minute capacity, driven by a 1 h.p. motor, to maintain a supply of water for the grounds, through a piping system three thousand feet long supplying four taps.

Other demonstrations which were made on the grounds, were strictly of farm machinery and appliances, there being about forty exhibits in all.

The farm of George Emelton, on which this demonstration was set up and on which many of the contests were held, took on the appearance of a large fair and became for the days of the Match the centre of attraction not only for local people but for the surrounding country, some coming from approximately one hundred miles each way, in Ontario, and one-half that distance in New York State.

National Safety Council
Detroit 1926

THE National Safety Council is an association of companies and other organizations interested in preventing accidents to employees in Industrial and Public Utility organizations, and also to the Public. As the Council was holding a Congress in Detroit, a delegation from the Commission was arranged which consisted of Messrs. J. D. Pace, J. J. Jeffrey, E. F. Latimer, D. M. Johnston, W. H. Mulligan, C. W. Moat and Wills Maclachlan.

The first thing that impresses one in attending this Congress is the number of delegates attending, the number of places represented and the type of men interested in accident prevention work. There were approximately 5,000 attending the Congress, representatives from practically every State in the United States and a number of Provinces in the Dominion, and it was noticeable particularly in connection with the larger companies, the number of senior executives that were present at the Congress.

The Council is organized so that there are a number of industrial sections, such as Metal Section, Rubber Section, Cement Section, Public Utilities Section, Electric Railway Section, etc. It has also sections organized in a general way such as Educational, Public Safety, Engineering, Public Health, etc. These various sections met and carried out their business in a very thorough-going fashion, there being very little lost motion in carrying out the work. There were upwards of one hundred papers presented to the different sections. One of the most important matters that impressed all the delegation was that the matter of accident prevention is

something very different from guards and safety devices. In other words the past and present living conditions and their bearing on the mental condition of the worker appears to have a considerable weight in leading up to numerous accidents, where definite instructions as to safe practices and the installation of all reasonable mechanical safe guards do not counteract nor eliminate. It would appear that the employer must have a more intimate knowledge of the mental attitude of the employee before assigning him to any particular job which is hazardous. The solution of the cause of the accident which is of a mental character is the big problem before those interested in accident prevention.

Next to preventing the accident, the rehabilitation of the injured workman is most important and the steps taken by the many and various organizations in this regard was most impressive. The returning of an injured workman to the industry on a self-supporting basis is a most humane act and the workman, instead of being a liability, becomes an asset to the industry and country.

It is quite impossible to give an adequate impression of the atmosphere at the Congress. The keen interest shown throughout in the technical type of papers clearly showed that much intensive work is being carried out to protect the physical plant. This, together with the educational work under the leadership of senior executives could not but impress one of the great advance that is being carried out in the prevention of industrial and public accidents. It is gratifying to know that in the Public Utility work the methods carried out in Ontario are well abreast with the most recent developments in the Public Utility in the United States.

Convention

O.M.E.A. and A.M.E.U.

at King Edward Hotel, Toronto

January 19 and 20, 1927.

High Frequencies and Short Radio Waves

By F. K. D'Alton, Assistant Laboratory Engineer, H.E.P.C. of Ont,

THERE are some peculiar and very interesting phenomena associated with high frequency voltages and currents in electrical circuits. These effects are due chiefly to the very large charging currents which appear, and the nature of the electromagnetic waves,—radio waves,—which are radiated from the conductors of the circuits.

At the exceptionally high frequencies, the radio waves, which are then "short waves" are unique in their behavior in travel, being quite different from the relatively longer waves used in the broadcasting of musical programmes.

Inductances and Capacities.

As frequency is increased from the very low values used for power transmission to the high radio frequencies, there is an increasing importance in some of the properties of the circuit, chiefly the inductance and capacity.

Inductance is ever present in a circuit to show itself in a tendency to prevent any changes in magnitude or direction of electrical currents, whereas capacity is also present in varying degrees tending to cause variations of current for even slight changes in voltages.

With the frequencies used for power transmission, 25-100 cycles per second, inductances are appreciable only where they consist of many turns of wire or are wound on continuous magnetic (iron) circuits of high permeability. Likewise, condensers, unless having very large capacity by containing a large area of plate surfaces or consisting of very long transmission lines in which the conductors form the surfaces, may not require serious consideration, so far as the power frequencies are concerned.

In the range of audio (voice) frequencies, 100-20,000 cycles per second, the inductances have many turns, but straight iron cores may be used leaving the magnetic flux to return through air, a path of high magnetic resistance. Condensers having fairly large capacities of 1 to 10 microfarads are very effective in telephone circuits in passing currents within this range and thus are important among the circuit constants.

The free radiation of power from circuits carrying audio frequency currents is inappreciable, however, and the influence of one telephone line on another, known as "cross talk", is an effect due to the magnetic fields rather than radiated energy.

High Frequencies.

Just above audio frequencies the band of radio frequencies commences, so called because energy is radiated into the ether of space and these radiations may be detected at a distance and used for communication

and other purposes. As the frequency increases a higher percentage of the total energy is radiated, increasing even as the square of the frequency.

In the radio frequency band,—20,000 to 60,000,000 cycles per second, the inductances omit the iron cores, and reduce in size, number of turns and diameter, as the frequency is increased. The condensers needed for telephone circuits are much too large in capacity, except for the lower radio frequencies, and are replaced by condensers even as low as 25/100,000 of 1 microfarad when working in the neighborhood of 10,000,000 cycles.

For the still higher radio frequencies, two short parallel wires may form a very effective condenser, and a sharp bend in one wire, or slight increase in length may add more inductance than is allowable in the circuit. On this account, the placing of parts, and spacing and directing of conductors is extremely important in radio equipment in order to avoid all undesirable additions to the inductances and capacity constants of the circuits.

In this connection, an interesting experiment was carried out on the first short wave transmitter built by the Commission to operate through a range of 5,000,000 to 15,000,000 cycles per second for communication between Cameron Falls and Toronto.

This transmitter was adjusted to 10,000,000 cycles per second, or 30 metres. In this adjustment there were only two and three turns in the grid and plate inductances respectively, and about .00002 microfarads in each of the two tuning condensers.

A 40 watt 110 volt electric light bulb was lighted to full brilliancy when attached to the aerial by *only one wire;* the other wire from the bulb was connected only to a metal plate, about 6 in. square, which was suspended freely in the air. This effect, of course, is due to the relatively large charging current to the metal surface at this high radio frequency.

The bulb could also be lighted by connecting it across one turn of the three-turn air core aerial inductance placed in the magnetic field of the plate coil.

In either of these experiments, the brightness of the light was controlled by one variable air condenser having maximum capacity of .00015 microfarads, about one quarter of the capacity of the main tuning condenser in an ordinary broadcast receiver.

The Behavior of Short Waves[1]

The radio waves caused by these very high frequencies may be used efficiently for long distance communication, but, strange as it may seem, they are not satisfactory for short distance work. The reason for this is the difference in behavior of the two parts of the wave which are radiated simultaneously, i.e.,

[1] "The Reflection of Short Waves," John L. Reinartz. Q.S.T., April, 1925, p. 9.
[1] "The Refraction of Short Radio Waves in the Upper Atmosphere," W. G. Baker and C. W. Rice—Midwinter Convention A.I.E.E., New York, February, 1926.
[1] "How are Short Waves Reflected?" H. A. Joyce. Q.S.T., July, 1925, p. 25.

the "ground wave" and the "sky wave". The ground wave, as its name implies, travels close to the ground, but it fades out within a very few miles, this distance being dependent upon the power of the transmitter. The sky wave, on the other hand, rises from the earth, travels without serious fading and is reflected (or refracted) by an upper conducting layer of the atmosphere, returning to earth at a considerable distance from the transmitting station. The sky wave signals are strongest where the waves first return, and become weaker beyond this distance.

Between the short range of the ground waves and the distant points where the sky waves return to the earth, the transmitting station *cannot be heard*, even with the most sensitive receiver.

It is not uncommon, however, to find that the signals carried by the sky wave are very much stronger at 1,000 miles distant than are those of the ground wave at 10 miles. In tests from the Laboratories on 30 metres, 10,000,000 cycles per second, in the early afternoon signals were about equal in strength on Danforth Avenue, Toronto, (8 miles) and at the Victoria Hotel, Fort William (600 miles)[2], the former evidently being the ground wave and the latter the sky wave.

The minimum range of the sky wave, known as the "skip distance" varies according to the time of day and the frequency, or wave length. The shorter the wave length,—i.e. the higher the frequency,—the farther the sky wave travels before returning to earth. Also, at night the skip distance for a given wave length is much greater than in daylight. The wave used at night between two stations, therefore, would not be suitable for communication in daylight and the day wave could not be used at night.

[2]Reported by Mr. Wm. Sutton, Victoria Hotel, Fort William.

The Commission's Stations

The station at Cameron Falls can communicate with Fort William in daylight on the same wave length used for reaching Toronto at night, but while this wave is reaching Fort William it is not audible in Toronto, and before appearing in Toronto it disappears from Fort William.

The establishing of communication between two fixed points,—e.g. Cameron Falls and Toronto, Fig. 1,—necessitated a certain amount of investigation before building the equipment, in order to determine the proper wave lengths to use so that the sky wave will return at the desired distance. Both day and night waves have to be found.

In this case the direct distance between stations is approximately 580 miles in a direction about N 49°-W and the course lies over both land and water. The geography of the course, however, does not appear to affect the sky waves in their travel.

The preliminary investigations showed that the wave length of 30 metres, 10,000,000 cycles, would be quite satisfactory for communicating in daylight only, but that the

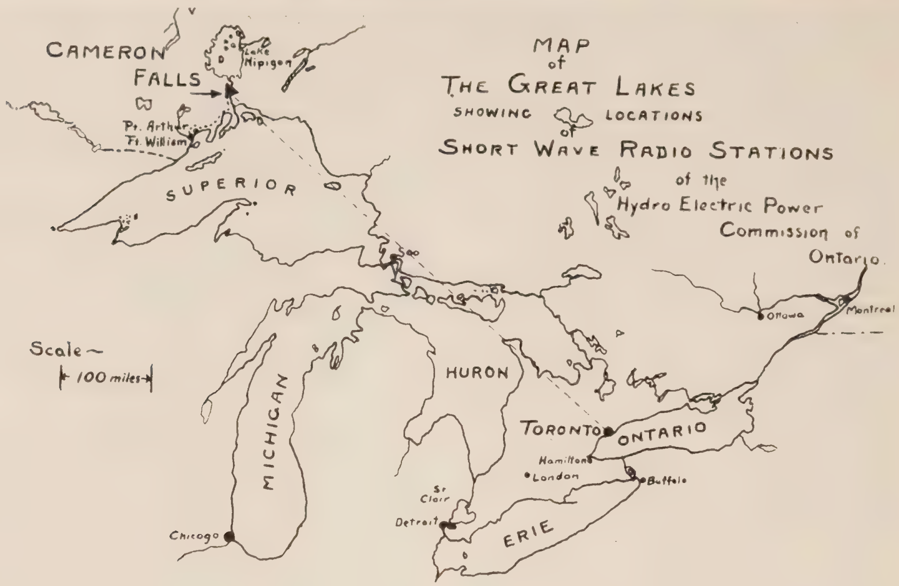


Fig. 1.

wave length of 50 metres, 6,000,000 cycles, was necessary at night.

The behavior of these two waves appears to be about as suggested by Fig. 2. The returning of the waves from the sky is attributed to an ionized layer of gas in the upper atmosphere, commonly referred to as the "Heaviside layer" which is much higher at night than during the day. Waves reaching these layers at certain angles are turned back in a very efficient manner but waves at other angles pass on into the upper atmosphere and disappear entirely, or if at a very low angle, they become ground waves and are quickly absorbed and dissipated.

It will be seen from the diagram that the 50 metre waves from either station will be returned at night from the upper layer (A) and reach the other station. This same wave during the day would be returned from the lower layer (D or E) and reach the earth too near (C) to the sending station to be of use for communication, even nearer than the diagram suggests.

The 30 metre wave from either station will be returned from the lower layer (B) during the day and reach the other station, but at night these waves pass to the higher layer (F or G) and do not return to earth until they have travelled several hundred miles beyond the other station.

The wave length, therefore, must be subject to change in both transmitter and receiver if day and night operation is desired.

During the sunrise and sunset periods, the reflecting layer seems to be gradually falling or rising, respectively, and the wave length would have to be frequently changed

if communication were required to be maintained at these times. On this account it is preferable to confine communications to the full daylight and full night periods where the waves can be kept steady.

Short waves permit both code and voice communication, although the latter, at the present stage of development, is not as true as on the longer broadcast waves.

The skip distance effects are not noticed on wave lengths above about 66[3] metres. The longer the wave the less is the absorption of the ground wave and, therefore, the greater its range. Also for the longer waves, the sky wave returns nearer to the station, even within the range of the ground wave so that there is not any silent zone. It is thought, however, that the confliction of sky and ground waves is the cause of the fading of signals at certain distances from broadcast transmitting stations.

For transoceanic radio communication on the very long waves, it would appear that the ground wave only is used.

Note—A description of the short wave radio equipment installed by the Commission at Cameron Falls and Toronto appeared in the October issue of the Bulletin.

[3] "Some Measurements of Short Wave Transmission," Heising, Schelleng and Southworth Journal I.R.E., October, 1926, p. 613.

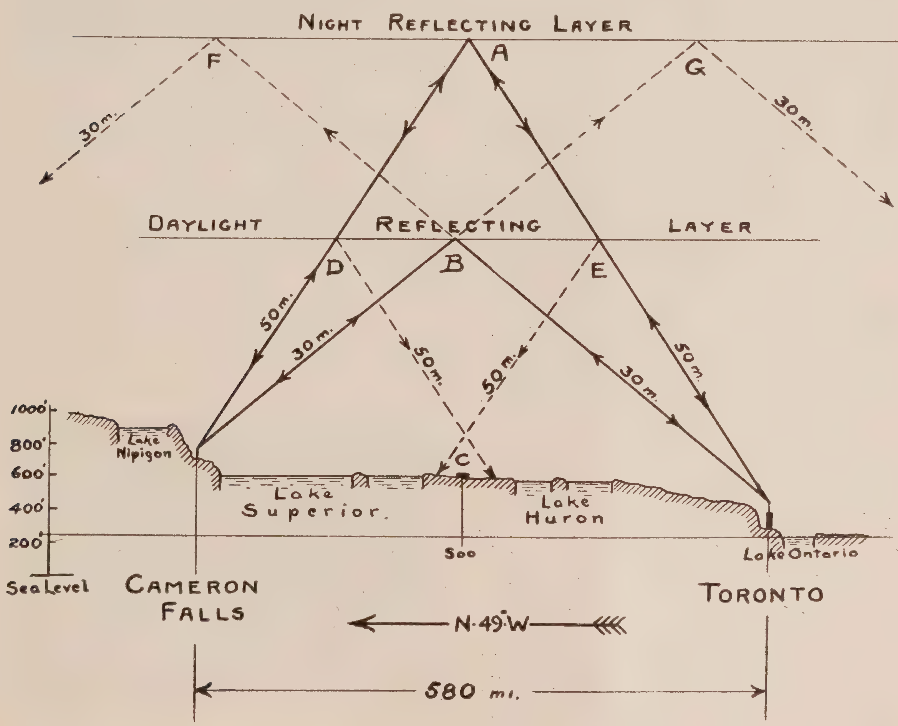


Fig. 2.

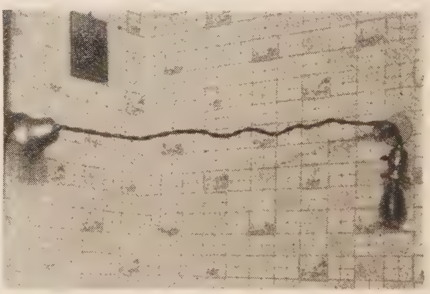
Another Bathroom Fatality

(The following refers to an occurance that was made the basis of a legal action, necessitating its being with held until this time).

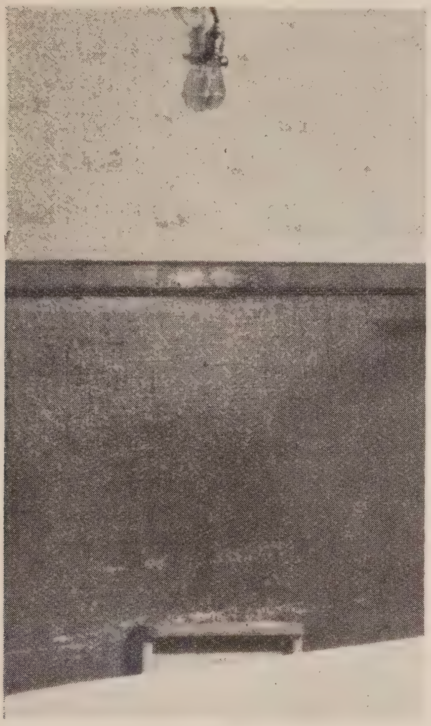
THE Toronto papers of April 30th carried headlines which many of you possibly have read with concern, showing that another young man had lost his life from electric shock while taking a bath. As has been pointed out in similar cases the shock was not due to high voltage having found its way into this building nor to any defect in the service. It was simply a case of misuse of fittings which might be perfectly satisfactory in their proper location, but which brought about a dangerous condition when installed in this bathroom.

As will be noted from illustrations, the electric light outlet is installed about 6 ft. from the floor, and just inside the door at one end of the bathtub. On the side wall over the bathtub is a gas outlet. It would appear that the young man who lost his life was somewhat of an amateur electrician and in defiance of the laws took it upon himself to install fixtures in this apartment to which his family recently moved. From the evidence obtained it would appear that in their previous apartment they had used drop cords for their lights, apparently from ceiling outlets. In the new location some of the outlets were intended for brackets, but the young man, in his ignorance, attempted to adapt the drop cords to the side wall outlets instead of purchasing new fixtures and having them properly installed and inspected. At any rate a cord such as that shown in the illustration was found by the police who answered the accident call, and the young man had evidently attempted to move the light while standing in water in the tub. The fibre lining of the brass shell socket moreover bore a water mark as though at one time or other it had dropped into water in the tub, thus making the shell of the socket alive. It was also noted that the cord used was of a standard heater cord type, and the socket cap was of the 1/8″ type without a cord bushing.

It may be interesting to note the result of some volt meter readings which were taken by inspectors from the Toronto Hydro-Electric System and the Electrical Inspection Department. The line voltage was 120 volts. The voltage from the live wire at the outlet to the gas pipe was the same and the voltage to the



Drop cord installed on wall outlet and hung over end of gas pipe.



Location of lamp over bathtub.

bathtub taps and metal drain was 119½. With water in the bathtub, the voltage from the live wire to the volt meter terminal in the water varied from 90 volts at a point about 1/4″ away from the metal drain to 30 volts at the other end of the bathtub, a distance of less than 4 feet, as the tub was quite small. The young man therefore was exposed to a voltage of between 30 and 90 volts between the defective brass socket shell and the water in which he was standing. As has been pointed out before, this voltage is quite sufficient to cause death if the current passes through the trunk of the body.

The newspaper reports of the accident state that the young man was carried from the bathroom and a doctor was called, artificial respiration being applied for an hour and a half without result.

We would take this opportunity of again sounding a warning against the use of electrical devices with metal frames in bathrooms. Of course it is illegal to install other than porcelain sockets in bathrooms, but many do not know that there is just as much danger from the use of electric air heaters, curling irons and vibrators which may become defective through breakdown of the insulation, leaving the frames alive. Many of the curling irons which have been sold in the last three years have proven defective in service due to breakdown of the insulation. Accidents have occurred due to defective insulation on vibrators and hair dryers. If these devices must be used in bathrooms they must be used with extreme caution, keeping clear of all metal parts and water. The only safe way to use them is to use them in some other room. If it is necessary to heat your bathroom electrically, do it with a stationary type heater, the frame of which is definitely grounded.

Those in charge of electric utilities can do a great deal to prevent accidents of the type which has been discussed above by warning the consumer to use portable devices in the proper manner, and by encouraging the installation of the proper equipment. There are on the market at the present time a number of combination brackets in which a

receptacle is mounted. These have been widely advertised as suitable for use in bathrooms. It will be seen from the above remarks that the installation of such receptacles is merely an encouragement for the uninitiated to use the curling tongs and electric heaters in a place where they should not be used.

Exchange of Motors

Enquiries are made frequently by municipalities regarding the exchange of 60 cycle motors used on household equipment for 25 cycle and visa versa. When consumers move from one municipality to another very often the frequency supplied to the new home is unsuitable for the equipment they own and consequently request the Local Manager to supply proper motors. A general exchange policy, especially affecting washing machine motors would be appreciated and a considerable saving could be made to the consumer and the municipaity if such were adopted.

Municipalities having motors of a different frequency than that of their systems, should arrange to get in touch with systems having frequencies that are suitable.

A Record Range Installation

To buy an electric range and to have it performing the duties for which it was desired, within the space of an afternoon approaches close to what may appear an impossibility in the ordinary course of a regularly operated Hydro Shop. Yet we have received from Midland the following brief statement of such an accomplishment.

"At 12.30 p.m., on October 19th, a lady visited the Midland Hydro Shop and purchased an electric range. Work on the installation was commenced at 1.30 which consisted of a new standpipe, entrance box and a 21 foot run to the range. The work was completed during that afternoon, the inspection certificate issued, and at 5.45 the range was in use for the preparation of the evening meal."

It was fortunate that the Inspector was in Midland that day else it would have been necessary to wait until his next visit before the inspection certificate could be obtained. Yet the Midland Hydro Shop is to be complimented on account of the expedition with which its part of the transaction was carried out. This was all in the course of an ordinary day's work in a shop that is busy.

In this town, of about 8,000 people and 1,480 domestic users, there were installed and placed in operation during the year 1925, 39 electric ranges in addition to 44 hot plates, 78 washers, 9 vacuum cleaners, 18 water heaters, 5 grates, 47 air heaters, 3 ironers, 106 irons, 7 refrigerators, 22 toasters and 46 grills.

The record of Midland is very encouraging, and might be set up as a target at which other utilities of similar size could aim.

Power Development in Ontartic and Quebec

Review of Past and Estimate of Future Hydro-Electric Installations in These Provinces.

There has been a rapid increase in water-power development in Canada during recent years. The low price at which hydro-electric power can be made available for industrial, agricultural, and domestic purposes has brought about a greatly increased use of electricity, and the growing demand, which has been mainly in the centres of industry in the St. Lawrence basin, has resulted in most of the major installations being undertaken in the provinces of Ontario and Quebec. On January 1, 1926, the total turbine installation in Canada was 4,290,428 horse-power, and of this total 3,532,228 horse-power was in stations and plants in Ontario and Quebec.

What proportions the development of water-power will reach in these two provinces and the approximate amount of new capital that will be required for that development are indicated by the results of a survey recently completed by the Dominion Water Power and Reclamation Service of the Department of the Interior.

In 1924 officers of the Service made an exhaustive investigation of the rate of growth of power demand, past and present, in the district termed "the Lower St. Lawrence Basin". This district includes practically the whole of the settled portion of the province of Quebec and of the southeastern or principal industrial portion of Ontario, and has a population of over 5,000,000. Nearly 30,000 industrial establishments and some 750 power-producing or power-using public utilities are located in this area; it is served by 27 railways, and has vast resources of timber, pulpwood, minerals, water-power, etc.

Quite recently the study was extended to ascertain the amount of new capital that will be required for water-power development to meet the demand for power for the whole of Ontario and Quebec. A reliable basis for the average capital cost per horse-power is furnished by the very complete Census of Central Electric Stations which has been compiled annually since 1917.

The net result of these two studies was that the estimated power required by the provinces of Ontario and Quebec will increase from 3,532,000 installed hydraulic turbine horse-power in 1925 to about 8,150,000 in 1945 and that the new capital required for development, transmission and distribution of this water-power will be not less than $1,369,000,000 during the 20 years or an average of over $68,000,000 per year.

That this estimate is conservative may be judged from the following facts. The average rate of increase in installed horse-power corresponding to the above figures is less than 5 per cent. per annum; the actual increase from 1923 to 1925 has been at the rate of over 18 per cent. per annum, and with the great developments on the Saguenay and Gatineau rivers, and smaller developments at other points, now under construction,

and the developments that may be expected on the St. Lawrence, Ottawa and other rivers in the next few years, a similar rate may be expected for some years to come.

—*Natural Resources, Canada.*

Electric Lighting Has No Saturation Point in Sight

The central-station company has no cause to worry about a saturation point in lighting. Illumination intensities are very generally far below those desirable or economically possible. The greatest convenience is far from having been achieved. The use of light for esthetic and specific psychological effects has barely begun. Then, finally, luxurious lighting is still to be developed.

It has been shown that from a purely utilitarian viewpoint the homes in this country are about half lighted. That is, for convenient and useful lighting the homes need at least twice as many outlets as they now have, much more lighting equipment and more than twice the present connected lighting load in watts. After this level shall have been reached there will still remain the job of raising the standard of utilitarian lighting. All this does not include any decorative use of portable lamps, brackets and other equipment or any of the enormous possibilities of distribution and quality of light for esthetic effect.

In our factories the level of illumination is very low. The best economy demands levels of illumination many times the present average. The same may be said of offices. In stores the level of illumination is being steadily increased, but the ultimate goal is not in sight. High-intensity illumination in show windows is far from what it could become, and the use of powerful artificial illumination for combating reflected images from windows has just begun. The tremendous potentialty of colored light and stage-lighting procedure are just beginning to dawn upon the display man. Cleverness in electrical advertising will keep that field growing for years to come. Electric lamps are now controlling traffic just as signals have guided railroad transportation, but only the surface of this field has been scratched. High-intensity street lighting is becoming recognized as one of the great aids in the traffic problem, and highway lighting is bound to expand enormously.

So it is in all fields. Artificial lighting is in its infancy. To be better than daylight is its goal, and the realization of that ambitious object will require enormous growth for generations.—*Electrical World.*

Electricity in Poultry Farms

IN all branches of industry to-day there is the keen desire to lower the cost of production and yet maintain a high state of efficiency. This is as true in the poultry world as it is in the factory. The engineer has contributed his quota to the efficiency of the present day industrial sphere, and the paper shows how the engineer can come to the aid of the poultry farmer.

While electricity can be utilised conveniently for all forms of power, it perhaps appeals most to the poultry farmer, as a means of lighting the laying house, the brooder house, and the incubator room. A very promising field for the use of electricity is the application of ultraviolet rays to hens and chicks. Tests with a mercury-vapour lamp were recently carried out at the Agricultural College of Wisconsin, with the result that hens subjected to a ten-minute ultra-violet radiation per day laid considerably more eggs than birds living under exactly similar conditions without ultraviolet treatment. The most advantageous period to apply the treatment seems to be from December to March, when chicks suffer from lack of sunlight. Two other electrical treatments which have been given to young chicks with remarkable success, but not on a commercial basis, are the operation of ozone-generating apparatus in the brooder house, under which the chickens also seem to thrive better than is usual, and the maintenance of a high-pressure charge on a wire or wires placed over the chicks, similar to electro-culture as applied to plants.

The use of electric lighting for increasing egg production during the winter months has proved to be one of the most important commercial innovations introduced into the poultry world during recent years. It has now long passed the experimental stage. The correct light intensity on the floor has been found to be from 0.8 to 1.0 foot-candle. It sometimes happens that although there is sufficient light on the floor, the lack of any direct light on the perches results in a number of birds failing to come down to feed.

A practical recommendation for the lighting of most poultry houses is the use of 40 watt vacuum-type lamps in extensive pattern reflectors. The lamps should be spaced about 10 ft. apart and placed about 6 ft. from the ground. Determining the position of these lamps is comparatively simple; what has to be borne in mind is that as far as possible there should be an equal intensity over the feeding space.

The poultry farmer should consider how he is going to turn the lights on and off, and as regularity is an all-important matter, the switching operations should not be dependent on the time-keeping of any workman. Many birds fall into an early moult if subjected to irregular hours of lighting. Before selecting an automatic time switch, the programme of lighting must be decided upon. This will depend partly upon the poultry farmer's

convenience and arrangements; partly on the breed of the birds; and partly on local circumstances, such as the prevalence or otherwise of rats and the charges for electricity. Experience has proved that it is better for the birds to switch on a dim light in hours of darkness before a full one, and also to dim before switching off, so as to allow the birds time to get on their perches. The author employs a clock which winds itself electrically, and, by means of an astronomical attachment, automatically follows the rising and setting of the sun for switching off and on. For morning and evening lighting, coupled with automatic dimming, the author has employed two cheap-pattern clock switches.—*Extract from "The Electrical Review"*.

Editor's Note—

The use of ultra-violet ray treatment direct from sunlight, by using "wire cloth glass" in hen houses, pig pens, etc., is being advocated strongly in this country for hens, young chicks and animals, and for other purposes. Sunlight in winter may be irregular, but this method of application has the advantage of reasonable cost of installation and no cost of operation other than maintenance. If lamps that will supply ultra-violet ray light become available at reasonable cost there is a possibility of developing the service in this country, as most of it would be in the months when rural users, in many cases, get into the "follow-up" rate for a large portion of their consumption.

"Come Out of the Kitchen"

WRITTEN BY JANE LANE

In publishing the following paper, the Bulletin does not express concurrence in all of the statements given therein. In that, however, much of what is said is no doubt true, we are publishing the paper complete, leaving it to the reader to pick out such suggestions as may prove useful.

TO the men of the Electric Service Industry I would extend the invitation which in the old nursery rhyme the spider gave to the fly: "Won't you come into my parlor?"

And you will forgive me if I entertain you in the first person, with the perpendicular pronoun, because all that I have to tell you is based on my own personal experience.

Recently I met a group of electrical women all associated with light and power companies and interested in the sale of all articles which add to the load and I was amazed to find that they spoke a language which I do not understand. I am one of those unfortunate women who cannot boil water and have it taste right. I never washed a garment in my life. I cannot iron and I do not know how to clean a room. I regret this, I feel that I labour under a handicap, but I have always been so busy doing other things I have never had time to do anything in a kitchen.

On the other hand, I can go into a hotel room—a bare, cheerless room, without personality or charm and with a couple of magazines, a newspaper, a book or two, violets for my belt, the bed lamp which is always in my traveling bag, my colorful negligee, my personal toilet articles, and in five minutes I can give you a room which looks "lived in", a room which makes instant appeal.

I found that these women in the electrical industry talked entirely in kitchen terms. They talked of electric washers, ironers, toasters, cleaners. They talked of labor saving devices and always from the standpoint of women who do their own work. The percentage of such women is very large, it is right that women should consider electricity from this standpoint first, but do not these women who do their own work get out of the kitchen part of the time? The kitchen is not the life of any modern woman.

I got some of these women as far as the dining room; they did talk of toasters, percolators and of some of the things which can be made on electric grills and electric stoves, but the dining room was as far as I could get them—they insisted upon staying in the laundry, the kitchen, and the dining room.

I tried to get them into the nursery. It seems to me that the electric service company can, with electricity, help every young and every experienced mother. You can give them instant light—almost instant hot water and heat. Did you

ever have a baby in your family suffer from croup? Have you any idea what it means to have hot water when you need it, if you live in the country where you cannot turn the tap and bring hot water immediately? And what percentage of people in this vast country do live in city apartments where hot water is as common as cold? How many of these city apartments give you boiling water at 4 o'clock in the morning, which is so often the dangerous hour in your baby's life?

I also tried to get them into the sick room, tried to talk about what electricity might mean there, and some of these modest women who could not bear to talk of babies, were quite as adverse to discussing sickness, which we are all willing to admit should not exist, but which has to be met more or less constantlv in life.

When I tried to get these women into the parlor and have them talk to me about lamps, which are used more and more in every modern home, and which consume much current, they looked at me as if I were discussing something quite foreign to the lighting company. And strange to say, I find upon investigation that this is a subject practically untouched by many light and power sales managers,—hence my invitation to come out of the kitchen and into the living rooms.

I find that the lamp (I mean the lamp complete, not merely the bulb) business has grown in some fifteen years—since the electric lamp became a practical electrical appliance with the advent of the modern bulb—into about ninety million dollars at wholesale. I find that a large percentage of lamps are sold by department stores whose sole interest is to sell at a profit, without any thought of rendering service to the people who buy lamps for two purposes—first, to give illumination; and second, to improve the appearance of homes.

Lamps have been a new and interesting addition to living rooms, and many women have purchased them indiscriminately because they make a color appeal or a price appeal. At present we have thousands of women who find themselves surrounded by lamps which individually are attractive but inefficient; and collectively in a room are discordant as well as inefficient.

In the future women will buy lamps because they know they are right for the place where they are needed, right from the standpoint of efficient illumination and right from the standpoint of decoration.

The electric lighting companies throughout the country have, in a measure, sold lamps, but they have held back the lamp industry by selling the wrong kind of lamps. For years they sold only glass shaded lamps; there are many places where a glass shaded lamp is needed, and where women would be glad to use them, but they also want softer, more interesting lamps for general use.

The lamps sold by the electric companies have in large part been bought by men who had no idea what the women wanted and why. The reason and logic back of it all

is so simple that it does not seem possible that men of intelligence have not grasped it. But they have not, as is proved by this statement written me by a man who is considered an authority on merchandising of all things electrical. This statement is to me incomprehensible, but I am convinced that it was written in a rare moment of honesty, when the writer told the simple, naked truth. Please read this statement carefully:

> "Personally, I am inclined to believe at this moment of heretical doubt, that successful lamp merchandising is not a matter of reason,—it is a matter of emotions and artistic sense. I put this in the class of buying homes, the joining of clubs or the selection of husbands. To none of these things can reason be really applied. We only make a so-called reasonable gesture and let it go at that."

This was written by a man for whose judgment I have much respect. I consider that he knows as much about the problem of electric service company merchandising as any man in this country. If he does not know how and why lamps are selected by women, most certainly the average lighting company man does not. I have always thought that the reason the light and power company has not taken a stronger hand in the lamp business was because they had a heavy load at night and were not interested in building up their load at that time. Perhaps there is another reason.

The electric company has a franchise to render service, their business is to sell current and the service they render is the pretty wrapping on the Christmas package which makes such an appeal to all of us. Certainly lamps consume current, most certainly every department store, furniture store, lamp shop and gift shop which has sold lamps during the last fifteen years has been working actively for the light and power company. A lamp and shade are sold, and the customer goes away. A lamp has an average life of from two to five years, depending upon the type of lamp. A shade has an average life of two years only. The store does not make any more money until the customer comes back for a new lamp, but the lighting company makes money on the sale of that lamp, in current consumption, just as long as the lamp holds together. Every lamp sold adds current to the electric company load, just as every radio sold adds current to the load, not because of the current used on the radio, but because the radio causes people to sit up late at night waiting for distant interesting programs. People do not sit in the dark and listen to their radios; they keep their lamps turned on, and the lighting company reaps the profit.

The quotation given from the electric company man convinces me that the electric service company has delayed coming out of the kitchen, into the parlor, and building up on its load on lamps because it does not know what it is all about. It thinks that lamps are "style" merchandise, varying from season to season.

It would be interesting to know how anybody ever conceived of

"style" in lamps. Some cloak and suit man, now in the lamp business, who for years made his money on the turn of the season's style, must have applied the word to lamps. There is no reason or logic back of it. If "period style" in the design were referred to that would be a different matter.

Lamps are used with furniture, hanging and rugs. Do you hear of seasonable style in furniture? Do the furniture people bring out new styles each season? Certainly not. Do the upholstery people claim to have style in hangings and coverings? Certainly not. They know that when furniture is inspired by the English then XVIII century period is used, upholstery of the same period will be used, and if a room is consistently decorated, the walls, the floors and everything used in that room will be in harmony with that period, although many things will be used which were not used at that time. We want in our homes all of the comforts of the 20th century, even if we use the fine designs which we have inherited from the earlier centuries.

There are among our modern lamps of all prices, lamps which are consistent for use with that particular English period, lamps which give excellent illumination and lamps which have value from the standpoint of decoration.

In many parts of this country we have a strong wave of interest in all things associated with the early American days. In the East we account for that by the opening of the New American Wing at the Metropolitan Art Museum. It is consistent and logical for women to be demanding lamps of pewter, brass, glass, iron and Chinese vases, lamps which fit into the picture of early American backgrounds.

In other parts of our country we have today an unprecedented interest in lamps of Spanish origin. Our importers are bringing in peasant-made pottery and models of old Spanish iron, from which to create modern lamps which belong with homes, the architecture of which is Spanish in design and whose rooms contain interesting articles, originals or duplicates from Sunny Seville.

Lamps are merely vehicles of electricity, they can assume thousands of forms, and the women of this country have for fifteen years been studying, consciously or unconsciously, the best in design of all times. To-day it is customary to find the average home in much better taste than a quarter of a century ago. We do not build French chateaus and Italian villas on crowded city streets, as we used to. The architects of this country have done much to improve the exterior of our homes. Horrible crimes have been committed in the name of interior decoration, but much more good than harm has been done by the decorator for the inside of the home. If you visit even the second rate department store in your town you will find the furniture in most cases labeled with the period style influencing it. You will find that price does not govern entirely good designs.

If you will look about you, you will be surprised to find young girls,

brides of to-morrow and yesterday, seriously studying furniture before they buy it. All their lives they have read magazines, newspapers, besides studying design in the elementary grade at school. They know there is a difference in what is correct and what is harsh evidence of poor taste. They are striving for the best.

Our women are the best dressed in the world, even if they do have a tiresome sameness, and they will in a very few years have more evidence of refinement in their homes than any country in the world. The old country calls it, "America groping for culture," and I, for one, am proud that the women of our country are groping.

Back of lamp selection, in the minds of women, is the desire to buy lamps which "belong" in their homes, lamps which are in keeping with their furniture, their hangings, and their rugs. They want illumination, they know that an attractive lamp will make or ruin a room. They know that the more lamps they use, the more flexibility they have in lighting effects, and they know much more than men that when you put several lamps into one room—and in a large living room eight or ten lamps are often used today—you must use much care or your room will look like a lamp shop and one color will fight with another. The wrong color in your lamp shades will kill every other color in your room.

The light and power company man will probably throw up his hands in horror and claim that he does not want to become an interior decorator. He does not need to. But, if he is to make money he can make in the next five years by increasing his load through the sale of lamps, he must see what is back of intelligent lamp selection, and he must render service to the women in his community.

As far as design goes, he can do what one of the biggest department stores in this country has done. This particular store, a model for all the world, has selected a woman who knows, paid her a salary which forces her to pay a tidy income tax, and this woman works with the buyers of furniture, rugs, upholstery, lamps, and all the things which go into the home. This woman has knowledge of design, innate good taste, is conversant with the demands of women today and assists these buyers in their selection of merchandise.

The buyer searches the market for the price, he does the bargaining, the buying, the merchandising and the selling. This woman consultant sees that all departments co-ordinate in design selection. When a customer enters that store, she can fit her home from top to bottom, selecting merchandise which is correct for her period style, whether early American, English, Italian, Spanish, French, or modern.

The electric service company might utilize the knowledge of women in selecting their lamps. If they did, a woman could go to the electric company, ask for information and be sure that the reply was correct. The lamp is the most complex thing in a room,—it is the spirit of the room, the intangible

something which controls all. Decorators are very apt to side-step the question of lamps, they know nothing of illumination, they do not understand color values by lamp light, so they very often play safe by recommending putty colored shades throughout a house, as this does not hurt their colors at night.

If the electric company used woman's knowledge of design and decoration and illuminating engineers' knowledge of foot-candles, they might become a real factor in the lamp world. More than this, they might build up their load by rendering real and needed service. Every new electric bulb which is placed on the market seems brighter, more intense, than the old types. Less current seems to be consumed but the bulbs need to be shielded from the eye. Statistics show an ever increasing number of our school children who need glasses. We must, if we keep faith with the coming generations, conserve eye-sight. The glaring electric light bulb must be shielded. Glare must be taken out of our schools, our offices, our factories as well as our homes.

Lamps must be constructed so as to eliminate this glare. If an electric company were to recognize the need and were to establish a lamp bureau, where women could go with their lighting problems, they would be amazed at the quick response they would receive from women on their lines.

It does not matter whether a company sells lamps, those who do believe in selling lamps can render immediate service by at once placing in the home the right lamp. Those who do not sell lamps can make recommendations, which may or may not be followed.

Lamps are used at night, in rooms which have no daylight. The electric company would help the women in their towns if they would put their lamp departments in their basements where they have no daylight and where they can demonstrate what they are talking about, and where a woman can see a lamp without daylight interference, as it is used at home at night.

And so I would say to electric service men, again: do "come out of the kitchen" and render service in the living rooms. You have made the lives of thousands of women happier and easier by showing them how to use electricity in the kitchen; won't you accept the invitation which women all over the country are unconsciously extending to you to come into the living rooms and show them how to have lamps which help them to see clearly, without eye-strain,—lamps which make their lives happier because you bring beauty into their homes, giving them designs in keeping with their furniture, their hangings and their rugs.

—*Electric Light and Power.*

HYDRO NEWS ITEMS

Central Ontario System

The formation of a new rural district outside the City of Peterboro has been approved by the Commission. This will involve taking over a distribution system now owned by the City of Peterboro serving about 450 consumers.

* * * *

The Oshawa rural district is now separate from the Oshawa system and serves about 400 consumers.

* * * *

It is probable that in Oshawa a change will be made in the office in order to secure better lighting for the local staff.

* * * *

In the City of Belleville the Commission has moved its local office to larger premises on Front St.

Georgian Bay System

Following completion of the work in Georgina R.P.D., Mr. E. W. Ward of Pefferlaw has beeen appointed Supt. of the district, taking over his duties on the 13th of October.

Niagara System

The Ingersoll Public Utilities Commission is remodeling and extending their local substation. They are using a modern idea in connection with the installation of the totalizing graphic meters, in that these are being installed at the local office, which is about five-hundred feet distant from the substation.

* * * *

The St. Thomas Hydro-Electric System has recently purchased an additional 1500 kv-a. three-phase, water cooled, 13,200/2300 volt transformer for its main substation, and is installing a duplicate 2300 volt bus structure, as well as increasing the size of 13,200 and 2300 volt oil circuit breakers.

* * * *

The Beachville White Lime Company, which has been supplied with power by the Commission for the past ten years, is increasing the size of its plant and is installing an outdoor substation, 13,200/550 volts, with a capacity of 450 kv-a.

* * * *

We have been advised that a new paper Company is being organized at Thorold for the manufacture of high grade tissue and waxed papers. The Company expect to begin production about January 1, 1927, and will require approximately 500 horsepower.

* * * *

Ottawa System

One of the oldest incorporated municipalities in the Province of

Ontario, the Village of Richmond situated some fifteen miles from the present City of Ottawa but which was incorporated while Ottawa was still Bytown, has applied to the Commission for an estimate covering the cost of a supply of power to the municipality.

Association of Municipal Electrical Utilities

Nominations for 1927

The scrutineers have submitted their report covering the nominations for officers of the Association of Municipal Electrical Utilities for the year 1927, as shown on the primary ballots. They are as follows:

*These names to appear on the election ballot—

PRESIDENT—*J. J. Heeg, *R. H. Starr, E. M. Ashworth, W. R. Catton, A. W. J. Stewart, E. I. Sifton, R. L. Dobbin, E. V. Buchanan.

VICE-PRESIDENT—*J.G.Archibald, W. R. Catton, J. J. Heeg, *W. E. Reesor, C. T. Barnes, R. J. Smith, O. H. Scott, A. W. J. Stewart, W. H. Childs, O. M. Perry, J. E. B. Phelps, J. R. McLinden, C. E. Schwenger, H. F. Shearer, E. V. Buchanan, J. H. Bennett, P. B. Yates, J. G. Jackson.

SECRETARY—*S. R. A. Clement.

TREASURER—*G. J. Mickler,*D.J. McAuley, R. C. McCollum, R. P. Darrell.

DIRECTORS (From the membership at large)—*W. R. Catton,*O.H. Scott, *J. E. B. Phelps, J. G. Archibald, *V. S. McIntyre,*O. M. Perry, *E.V. Buchanan, F. C. Adsett, E.M. Ashworth, J. G. Jackson, A. B. Scott, T. W. Brackinreid, P. B. Yates, R. L. Dobbin, E. J. Stapleton, W. H. Childs, V. B. Coleman, J. R. McLinden, A. W. J. Stewart, J. E. Skidmore, J. E. Brown, H. F. Shearer, S. Buckrell, J. W. Bayliss, J. E. Teckoe, Thos. M. Staunton, H. P. L. Hillman, H. G. Hall, H. McQueen, D. B. McColl, W. E. Reesor, G. E. Chase, C. C. Folger, R. H. Starr, J. J. Heeg, G. W. P. Every, C. T. Barnes, A. M. Bowman, W. G. Breen, R. H. Martindale, D. R. Brockbank.

DISTRICT DIRECTORS:

NIAGARA DISTRICT—J. E. B. Phelps, *H. G. Hall, *J. G. Jackson, E. V. Buchanan, E. I. Sifton, W. R. Catton, P. B. Yates, H. F. Shearer, V. S. McIntyre, J. G. Archibald, D. B. McColl, Miss M. Grant, O. M. Perry, J. W. Peart, E. M. Ashworth.

CENTRAL DISTRICT—*G. E. Chase, *C. T. Barnes,*V. B. Coleman, F. C. Adsett, W. E. Reesor, R. L. Dobbin, O. H. Scott.

GEORGIAN BAY DISTRICT—*E. J. Stapleton, *H. Campbell, C. E. Brown.

EASTERN DISTRICT—*R. J. Smith.

NORTHERN DISTRICT—*T. W. Brackinreid, *S. A. Saylor.

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in October, 1926.

Appliances

THE BRANTFORD OVEN & RACK CO. LIMITED, Brantford, Ont.

Electrically-heated Bread Proofer.

* * * *

CANADA WIRE AND CABLE CO., Leaside, Ont.

Electric Refrigerator. Style Nos. B2 and K7.

* * * *

CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ont.

"Pyrox" Water Heaters.

Flat Rate Heater, S—H21203.

Circulation Heater, S—H21204.

"Westinghouse."

* * * *

FIRESTONE TIRE AND RUBBER COMPANY OF CANADA, LIMITED, (Submittor).

NATIONAL EQUIPMENT COMPANY (Mfr.), Akron, Ohio.

Electric Vulcanizing Spotter.

Marking: Manufacturer's name and address, and rating in volts and watts stamped in the metal frame.

* * * *

HUTCHINSON ELECTRIC, 188 Mississaga St. E., Orillia, Ont.

"Hutchinson" Electric Range.

Electric Hotplates, single and double burner.

* * * *

KELLOGG MANUFACTURING COMPANY, Rochester, N.Y.

Motor-Operated Air Compressors, Models E.M.201, E.M.251, E.M. 1222, E.M.261, E.M.62.

* * * *

NATIONAL ELECTRIC APPLIANCE COMPANY, 8301 Madison Avenue, Cleveland, Ohio.

Electric Cigar Lighter.

* * * *

RENFREW ELECTRIC PRODUCTS LIMITED, Renfrew, Ont.

"Canadian Beauty" Stove, single plate, Cat. Nos. 12 and 14 respectively.

"BEAVER" Stoves, single plate, 5 ampere, Cat. Nos. 201B, 235B.

* * * *

J. SKLAR MANUFACTURING CO., 133-143 Floyd St., Brooklyn, N.Y.

Therapeutic Lamps "Stein-O-Lite" and "Heliolite".

* * * *

UNITED DRUG CO. LIMITED, (Submittor), 68 Broadview Ave., Toronto.

THE FRANK E. WOLCOTT MANUFACTURING COMPANY (Mfr.), Hartford, Conn.

"Electrex" Curling Irons, Cat. Nos. 8, 9 and 10.

Marcel Waving Irons, Cat. Nos. 53, 54 and 55.

"Electrex Jr." Curling Irons, Cat. Nos. 15, 24, 25 and 26.

Beauty Sets, Cat. Nos. 77, 78 and 79.

* * * *

WILLARD STORAGE BATTERY CO. OF CANADA, LIMITED, 269 Campbell Ave., Toronto.

Radio A and B Power Unit.

* * * *

*Canadian Westinghouse Company Limited, (Submittor), Hamilton, Ont.

Westinghouse Electric & Mfg. Co. (Mfr.), George Cutter Works, South Bend, Ind.

Hot Cathodes, portable type for charging small batteries "Rectigon". Style Nos. 424501, 463992, 465912, 465921, 465943, 465976, 465985, 465988, 465994.

Hot Cathodes, public garage type "Rectigon". Style Nos. 375243, 375830, 375841, 375847, 439424.

Mercury Arc Type, for use on 125 and 250 volt a.c. circuits,

For telephone battery charging, Type AT.

For moving picture arc lamps, Type AL.

Marking: Nameplate with electrical rating.

* * * *

*Chicago Hardware Foundry Co. Limited, (Submittor), 77 Adelaide St. W., Toronto.

Chicago Hardware Foundry Co. (Mfr.), North Chicago, Ill.

"Sani-Dri" Electric Machine.

Marking: Nameplate giving rating, trade name and manufacturer's name and address.

* * * *

*The Q.S.R. Music Company Canada Limited, (Submittor), 590 King St. W., Toronto.

Copeland Products, Inc. (Mfr.) Detroit, Mich.

"Copeland" Models C and D, household refrigerator.

Models C and D identical except Model D provided with wooden base.

Marking: "Copeland" Models C and D on nameplate attached to motor base.

* * * *

*Electric Heating Co. Ltd., 677-79 Notre Dame Ave., Winnipeg, Man.

Water Heater, immersion type.

Marking: Nameplate giving manufacturer's name, trade name "Red Seal" and rating in volts and amperes.

* * * *

*Fleron & Son, M.M. Inc., 113 N. Broad St., Trenton, N.J.

Lightning arrester, air-gap type for indoor or outdoor use.

Type S, Cat. No. 20. Lead-in bushing consisting of brass lead-in conductor and porcelain insulation.

Marking: Manufacturer's name.

* * * *

*Halliwell-Shelton Electric Corporation, 113-119 Fourth Ave., New York, N.Y.

Portable Electric Hair Dryer. Type E-40.

Marking: Nameplate.

* * * *

*Killark Electric Mfg. Co. 3940 Easton Ave., St. Louis, Mo.

"Killark" Bell-ringing transformers, air-cooled. "White Bell"; "Blue Bell" Cat. Nos. 6166, 7166.

Marking: Name and rating on device.

* * * *

*LeMur Co. The S., 717 Superior Ave., N.E. Cleveland, Ohio.

Permanent Hair Waving Machine.

Marking: Nameplate with rating.

* * * *

*Manning, Bowman & Co., Meriden, Conn.

Electric Soldering Irons, Cat. Nos. 120, 120/12.

Marking: Manufacturer's name and catalogue number.

Electric Curling Irons, Cat. Nos. 110/1, 110/3, 110/8.

Marking: Manufacturer's name.

Portable Cooking and Liquid Heating Appliances:

Disc stoves,

Percolators,

Tea ball tea pot,

Toasters,

Table stoves,

Waffle Irons.

(As listed on Underwriters' Laboratories card dated August 27, 1926.)

Marking: Manufacturer's name and address and catalogue number.

* * * *

*INTERNATIONAL SILVER COMPANY OF CANADA, LIMITED, (Submittor), 375 Madison Avenue, Toronto.

MANNING, BOWMAN & CO. (Mfr.), Meriden, Conn.

Tobacco lighters, Cat. Nos. 101-S, 101/1, 101/2.

Marking: Manufacturer's name, address and rating.

* * * *

*WELLS MFG. CO., 673 Folsom St., San Francisco, Calif.

Combination of two waffle irons on metal base with individual snap switch control and pilot lights.

Marking: "Wells".

* * * *

Switches

THE GENERAL ACCESSORIES CO. LTD., 125 High Holborn, London W.C.1, Eng.

Surface Switches.

Single pole, with metal cover, Cat. No. 25 BX.

Porcelain sub-base for use with surface snap switches.

* * * *

A. G. MILTON, (Submittor), 67 Frederick Street, Toronto, Ont.

GEORGE ELLISON (Mfr.), Perry Barr, Birmingham, Eng.

Single and multi-pole, air-break circuit breakers with or without automatic overload and low-voltage protection, manually-operated. Mill type, Cat. List No. 17.

Single and multi-pole, air-break circuit breakers, with overload protection, switchboard mounting, manually operated, Cat. List No. 21.

Star-delta and series-parallel, motor-starting switches of the air-break type, Cat. List No. 117.

Change-over switches of similar construction to above, Cat. List No. 31.

Automatic limit switches consisting of enclosed copper contacts, butt type, quick-make and quick-break.

Shunt type, single pole, Cat. List No. 301.

Series type, single or double pole, Cat. List No. 301.

Push button emergency switch, single pole, Cat. List No. 11.

Disconnecting switches of the totally enclosed type, Cat. List No. 27.

Oil-immersed switches with or without overload and low-voltage release. Manually-operated, totally enclosed, Cat. List No. 26.

Star-delta and series-parallel motor starters with automatic overload and low-voltage protection in running position only. Manually-

operated, totally enclosed "V" contacts, Cat. List No. 121.

Change-over switches similar to above, Cat. List No. 41.

Motor-starting rheostats of the air or oil-cooled types.

Oil-cooled rotor starters for use in rotor circuits only, Cat. List No. 76.

Oil-cooled rotor starters and control panels consisting of the above starters and oil-break circuit breakers, Cat. List No. 81.

Air-cooled rotor starters, Type B, Cat. List No. 86.

Air-cooled rheostatic starters, Type C, Cat. List No. 106.

Air-cooled resistance type controllers.

Auto-transformers, motor-starting panel consisting of oil-immersed transformer and manually-operated oil switch, Cat. List No. 131.

Marking: Nameplate with rating.

* * * *

*CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, (Submittor), King & Simcoe Sts., Toronto.

GENERAL ELECTRIC CO. (Mfr.), Wiring Supplies Div., Bridgeport Conn.

Flush Switches (As Listed on Underwriters' Laboratories card dated June 29, 1926).

* * * *

*HART & HEGEMAN MFG. CO., THE, 342 Capitol Ave., Hartford, Conn.

"H. & H." Surface Switches (As listed on Underwriters' Laboratories card dated August 20, 1926).

* * * *

*HART MFG. CO., THE, Hartford, Conn.

Series-multiple snap switches combined with plug type fuse base, for use only on electric ranges.

Single-pole Cat. Nos. 1840, 19181, 18353, 18581, 181811.

Double-pole, Cat. Nos. 1918, 1922, 1935, 19352, 19952, 1995, 19351.

Marking: A letter "H" in a diamond.

* * * *

*UNION ELECTRIC MFG. CO., Milwaukee, Wis.

Motor-starting rheostats, Bulletins 1020, 1220, 2120, 6030, 6175, 7075.

Drum controllers for industrial service, Bulletin Nos. 3500, 3510, 3520, 3525, 3530, 3535, 3600, 3650, 8250, 8275, 8500, 8550, 8600.

Marking: Manufacturer's name, address and the rating.

* * * *

Fittings

FRANKE, LEVASSEUR & CO. LTD. 150 Craig St. West, Montreal, Que.

Porcelain split knobs for use with No. 14 to No. 10 inclusive standard rubber-covered wire. "D" enclosed in a circle.

* * * *

*CONNECTICUT ELECTRIC MFG. CO., THE, Bridgeport, Conn.

Receptacles for attachment plugs and plugs 10 amperes, 250 volts, Cat. Nos. 970, 980, 990, 1056, 1075, 1095, 1099.

Adapter, 660 watts, 250 volts, Cat. No. 1081.

Combinations of single, double-pole, or three-way flush type toggle switch, single or double outlet receptacle for attachment plugs, and indicator lamp on single Bakelite base, 10 amperes, 250 volts, Cat. Nos. 6101-03 incl., 6111-13 incl.

10 amperes, 125 volts, Cat. Nos. 6150, 6161-63 incl., and 6170.

Marking: "C. E. M. Co."

* * * *

*Hamilton Co., S. Ward, 152nd St. and Stone Ave., Harvey, Ill.

Outlet Boxes and Plates (As listed on Underwriters' Laboratories card dated April 1, 1925).

* * * *

*Hart & Hegeman Mfg. Co., (Submittor), 342 Capitol Ave., Hartford, Conn.

Paiste Co., H. T. (Mfr.), 3201 Arch St., Philadelphia, Pa.

Medium Base Sockets (As listed on Underwriters' Laboratories cards dated June 2, 1926 and September 10, 1926, respectively).

Receptacles for attachment plugs and plugs 660 watts, 250 volts, Cat. Nos. 415, 1414, 1430, 1445, 1447, 1449, 1451, 1454, 1468, 1476, 1477, 1482, adapter, Cat. No. 1404. 10 amperes, 250 volts, single and double outlet composition base, Cat. Nos. 1435, 1493, 1494, 7006-7-8, 7130. Porcelain base, Cat. Nos. 1440, 1492, 6095.

Marking: "Paiste" or "H. & H."

Marking: "H. & H." or "H.T. P. Co."

* * * *

*Propp Co., The M., 524-28 Broadway, New York, N.Y.

Receptacles for attachment plugs and plugs.

10 amperes, 250 volts, Cat. Nos. 120, 220.

Marking: "Propp."

* * * *

Miscellaneous

*Northern Electric Co. Ltd., 121 Shearer St., Montreal, Que.

Rubber-covered Wire.

Marking: Yellow thread woven in braid, or one red and one brown thread crossing in braid, or one red, and one brown thread parallel to wire under braid, or one blue, green or black thread in a red braid.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

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Fort William Joins Hydro Family

ANOTHER city of importance joined the Hydro family on December 8, 1926, when the city of Fort William officially terminated a 20-year contract with the Kaministiquia Power Company and commenced receiving power from the Hydro Nipigon development. The occasion was made one of celebration which was in the form of a public meeting held in the Auditorium of the City Hall.

The proceedings opened with Col. S. C. Young, Chairman of the local Commission, in the chair. He briefly reviewed the history of power in the city and asked Mayor Joseph E. Crawford to extend a welcome to the visitors. Mayor Crawford said: "We are here to-night to participate in an important event, far more important than most of the citizens realize. It is important to me in two ways. It marks a step forward in our industrial life and it is also an anniversary of my arrival at the Head of the Lakes." The Mayor traced the growth of the city from his initiation to the North Country, twenty years ago, to the present time.

Following Mayor Crawford, Col. S. C. Young addressed the meeting as Chairman of the local Commission and he reviewed the history of the development of power in the Thunder Bay District from the days of the late James Conmee in 1895 when the first mill was erected in the district. He told of the franchise obtained by Mr. Conmee and held until the late Sir Adam Beck came into office as the first Chairman of the Hydro-Electric Power Commission of Ontario. Col. Young continued his story to the point of actual development at Cameron Falls with Port Arthur as the first subscriber.

Commissioner C. A. Maguire of the Hydro-Electric Power Commis-

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sion of Ontario, who was the principal speaker of the evening said he was glad to be present to see the culmination of the vision of the late Sir Adam Beck. He declared he intended to be frank, and, notwithstanding the fact that the Kaministiquia Power Company had given to Fort William splendid service in the past, he still contended that the waterways of a country should not belong to any private concern. The object of private investors necessarily must be, he contended, to get profits and dividends. The Hydro-Electric Power Commission's principle was to develop all water powers not alienated from the people and, thereby, to assist the people of the province to a greater extent than would be possible in any other way. Mr. Maguire went on to tell of the relations of Toronto with the Hydro and said that the capital of the province was many millions better off because of those relations. The Hydro Commissioners, he said, today were the trustees for 480 municipalities with investments of more than $280,000,000. More than 80 of these municipalities had paid off their entire indebtedness.

Mr. Maguire went on to refer to the 53,000 h.p. that are being delivered now from Nipigon. This fact showed the clearness of the vision of Sir Adam Beck and he paid a glowing tribute to the memory of the man who had been such a dominant factor in Ontario's great power enterprise. "Without the development at Nipigon," the speaker asked, "what would be the condition at the head of the lakes to-day with a demand for 53,000 horsepower?" Industry, he declared, will follow cheap power, and for that reason he was confident absolutely of the future of Fort William and Port Arthur for they were surrounded with vast resources and they would have cheap power. When all obligations are paid off, he said, the power would be supplied at greatly reduced cost and then it would be impossible to keep industries away.

Commissioner Maguire declared that the Ontario Hydro now is developing nearly a million of horsepower and its record was unparalleled in the world. All honour, he claimed, was due to Sir Adam Beck.

Referring again to the development at Nipigon, the speaker said that 75,000 h.p. now could be developed there and the development of an additional block of 54,000 h.p. was imminent at Alexander Falls, a mile and a half from Cameron Falls.

To Chairman C. A. Magrath of the Hydro-Electric Power Commission of Ontario, fell the duty of pressing a control button installed on the stage to operate the breakers that would cut off the Kaministiquia power and connect the Fort William system with the Hydro Nipigon lines. His talk was of a reminiscent nature, because Mr. Magrath, who styles himself an Irishman, came to Prince Arthur's Landing forty-eight years ago by one of the old Beatty line steamers. "Do you know that when I landed at Prince Arthur's Landing, the steamer did not discharge any more cargo than would fill a birch bark canoe." He compared those conditions with to-day. From Prince Arthur's Landing, Mr. Magrath went to Duluth and from there to Winnipeg. From Winnipeg it was a three weeks' journey to Saskatoon and Regina. "You see what development has taken place in the last half century? Can you picture in your mind what is to take place in the next fifty years? We are only just starting this Canada of ours. We must give in order to receive and we must co-operate one with the other so that the best that we have may be given to the future generations."

In concluding his remarks, Mr. Magrath stepped to the front of the platform where the control button had been placed and operating the same, said: "The best wishes to you. Take care of your power. Co-operate with your local organization. Consider the people whom we serve. I officially declare Hydro power into the city of Fort William." As he pressed the button the Auditorium was cast into darkness for a moment, then the lights came on again and the ceremony was at an end.

The Hydro-Electric Commission of Fort William

TWENTY-EIGHT years ago, or, to be exact, March 1st, 1898, the citizens of the then town of Fort William voted and approved a by-law for the installation of an electric light plant.

Water-power, while it was available, was not utilized, largely on account of the cost involved, and so a steam driven plant was installed on the banks of the Kaministiquia River, near the junction of Frederica and Sprague Streets. This was of 200 h.p. capacity. However, it was not long until the increased demand for light had to be met, and by 1903 the little plant was overloaded, and in that same year a larger steam power plant was installed, with a capacity of 600 h.p.

A portion of the building that contained the electric light plant was used for pumping water from the Kaministiquia River, which at that time, and for many years before, was the chief source of supply for domestic use in this community. It was quite evident from the

ordinary growth that this power plant would soon have to be increased. Meanwhile, negotiations which had started in the year 1900, and continued for nearly five years, were soon to be realized, namely, the development of power at Kakabeka Falls, about twenty miles distant. A strong financial institution got control of the rights of this development, and in December, 1906, the work of harnessing the Kakabeka Falls, which for years had been the dream of the early settlers, was actually accomplished. At this time, the town entered into an agreement with the company for a supply of 600 h.p. which was more than the requirements for its commercial and domestic uses demanded, and so, on December 8th, 1906, the town closed down its steam plant, and power from the Kaministiquia Power Company was turned into the town's distribution lines.

So great has been the demand for power since 1906, that the entire Kaministiquia Power Company's output of 35,000 h.p. is practically contracted for, and, in addition, the Hydro-Electric Power Commission of Ontario are supplying 10,000 h.p. to the Great Lake Paper Company, Ltd., in this City.

Starting in 1898 with no electric light customers, and with only a demand in 1906 of less than 600 h.p. the demand for commercial and domestic light and electric cooking has grown so that in the year 1926, the City Utilities alone require 7,200 h.p. They have to-day 5,808 meters in service as follows: 3,472 on domestic light consumers; 838 on commercial lighting; 1,379 on electric ranges; 49 on commercial heating; and 70 on small motors.

In the early part of 1926 the Hydro Electric Commission of Fort William was founded by the city of Fort William. This consisted of the late Mr. J. P. Jones, Chairman, Mr. J. E. Crawford, Mayor, and Col. S. C. Young. The 1926 Commission now consists of Col. S. C. Young, Chairman, Mayor Crawford, and Mr. W. J. Ross. Mr. C. J. Moors is Manager, and Mr. A. McNaughton and Mr. Harry James are respectively Secretary and Treasurer, of this Commission.

Fort William Transformer and Sub-Stations

New 110 kv. Transformer station erected by Hydro-Electric Power Commission of Ontario and New Sub-station erected by Hydro-Electric Commission of Fort William to supply power to city of Fort William.

THE City of Fort William situated at the head of the Great Lakes amongst the vast resources of raw materials of the Thunder Bay district has now become one of the municipalities to be served with power from the Hydro-Electric Power Commission's, rapidly growing Thunder Bay System.

The stations described herein are those built to enable the City of Fort William to take power from the Hydro-Electric Power Commission of Ontario upon expiration of the contract between the city and the Kaministiquia Power Company on December 8th, 1926.

To supply this power it was necessary for the Hydro-Electric Power Commission of Ontario to erect in Fort William, a transformer station of 15,000 kv-a. capacity to transform the voltage from 110 kv. to 22 kv. at which voltage power is supplied to the city.

It was further necessary for the Hydro-Electric Commission of Fort William to erect a new substation with modern electrical equipment, to replace their former power and street railway substations.

The engineering work in connection with the municipal substation, the ordering of new electrical equipment and the installation of the entire electrical layout was done by the engineering and construction staffs of the Hydro-Electric Power Commission of Ontario at the request of the Hydro-Electric Commission of Fort William.

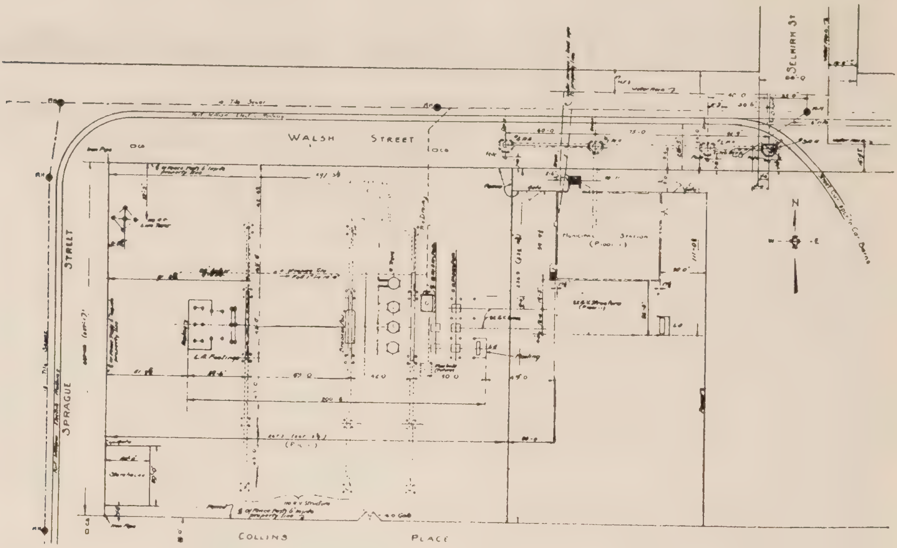
The station building and outdoor steel structure adjoining same was erected by contract.

The 110/22 kv. transformer station and the city substation are erected on adjoining properties at the corner of Sprague and Walsh Streets, Fort William, practically at the centre of gravity of the present load requirements with due consideration given to future load developments in the city.

110 kv. Transformer Station.

The entire 110 kv. and 22 kv. electrical equipment of the Fort William Transformer Station has been erected outdoors.

Power is supplied to the transformer station at 110 kv., 60 cycles from the Nipigon Generating Station through the 110 kv. station at Port Arthur. A 22 kv. tie line has also been run between the Port Arthur and Fort William Transformer Stations, a distance of approximately 12 miles, to provide for an interchange of 22 kv. power between the two stations as load conditions in either city demand. The necessary



Site Plan of Stations

graphic totalizing metering equipment has been installed on this feeder to record the power supplied over same to either station.

The present transformer installation of the Fort William station consists of one bank of 3-5,000 kv-a., 60 cycle, single phase 63,500 volt Y, 22,000 volt delta, outdoor, oil insulated, self-cooled, radiator type transformers with one complete transformer as spare.

The 5,000 kv-a. self-cooled transformers are filled with oil having a freezing point of 40° cent. They are equipped with manually operated tap changers on the primary and secondary windings so that the taps may be changed quickly and conveniently when necessary. The temperature indicating equipment on these transformers consists of a hot spot temperature indicator, also a thermocouple located at the bottom and top of the core so that the hot and cold oil temperatures can be obtained, also the hot spot temperature whenever required. The temperature indicating instruments and selective switches are mounted on a separate panel in the control room.

The present station consists of one incoming 110 kv. line, 110 kv. connections and three outgoing 22 kv. three phase feeders. The design is so arranged that future additions may be provided.

The 110 kv. line comes into the station through a set of combination choke coil and rotary disconnecting switches mounted on the galvanized steel structure of the station. A 110 kv. outdoor oxide film lightning arrester is connected to the line by means of suitable clamps attached to an extension of the choke coils. Grounding switches are also in-

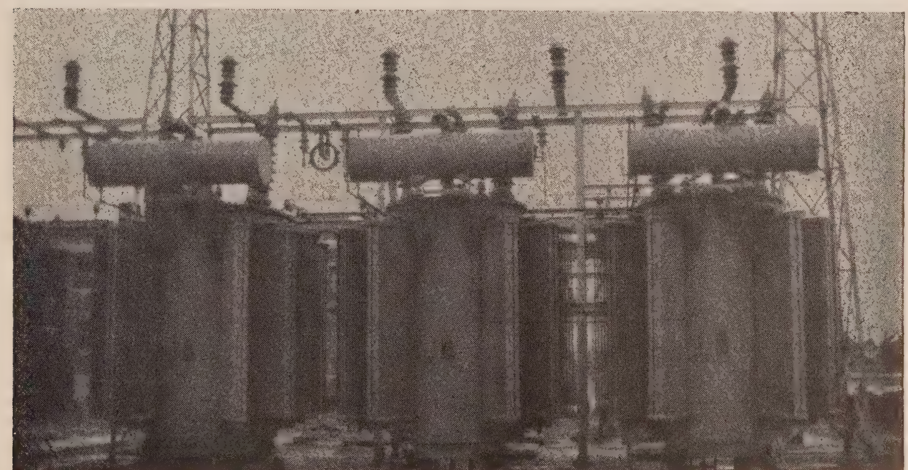
stalled at this point for the purpose of grounding the line when necessary.

The rotary switch in each phase is operated by remote control from the ground by a separate manually operated mechanism so that each phase of the line can be closed in seperately for convenience when testing. Pallet switches are attached to the mechanism of the three switches and connections have been run between these pallet switches and control switchboard so that a dummy disconnecting switch in the dummy bus work on the control board operates automatically to give the operator an indication whether the three disconnects are open or closed. The 110 kv. rotary disconnecting switches to be installed on the future extensions to this station will have a similar indication.

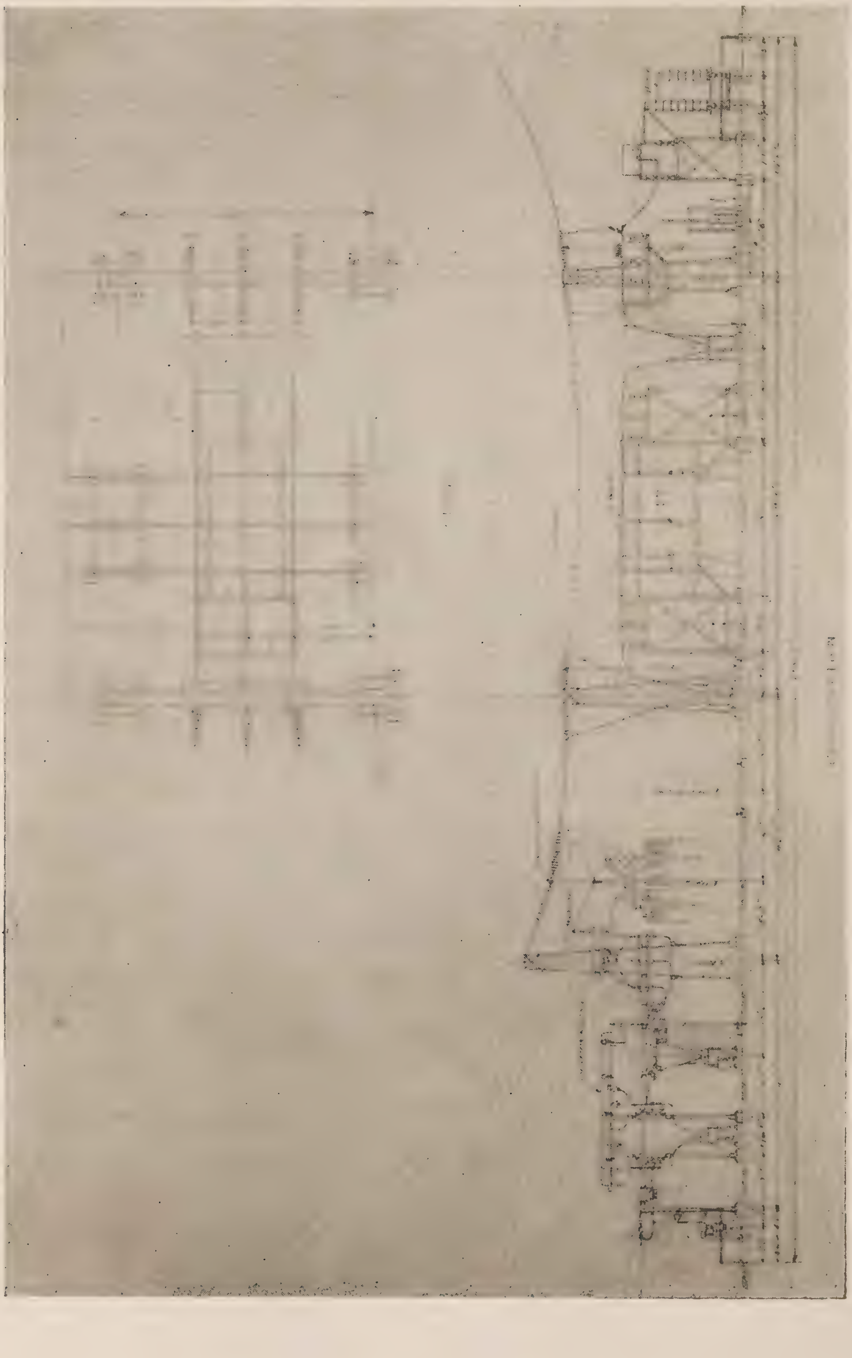
From the line disconnecting switches the 110 kv. connections are run on strain insulators direct to the transformer bank as this station is at present controlled, as far as the 110 kv. switching is concerned, from the Port Arthur transformer station. A 110 kv. outdoor full automatic oil circuit breaker will be installed on a concrete foundation in this station shortly.

The present installation does not require a 110 kv. bus but when a second transformer bank is installed or second incoming line a 110 kv. bus section will be necessary. This station has been designed for a future 110 kv. bus constructed of 2½ inch iron pipe supported on post type insulators on concrete footings which would place the main bus 12 feet above ground.

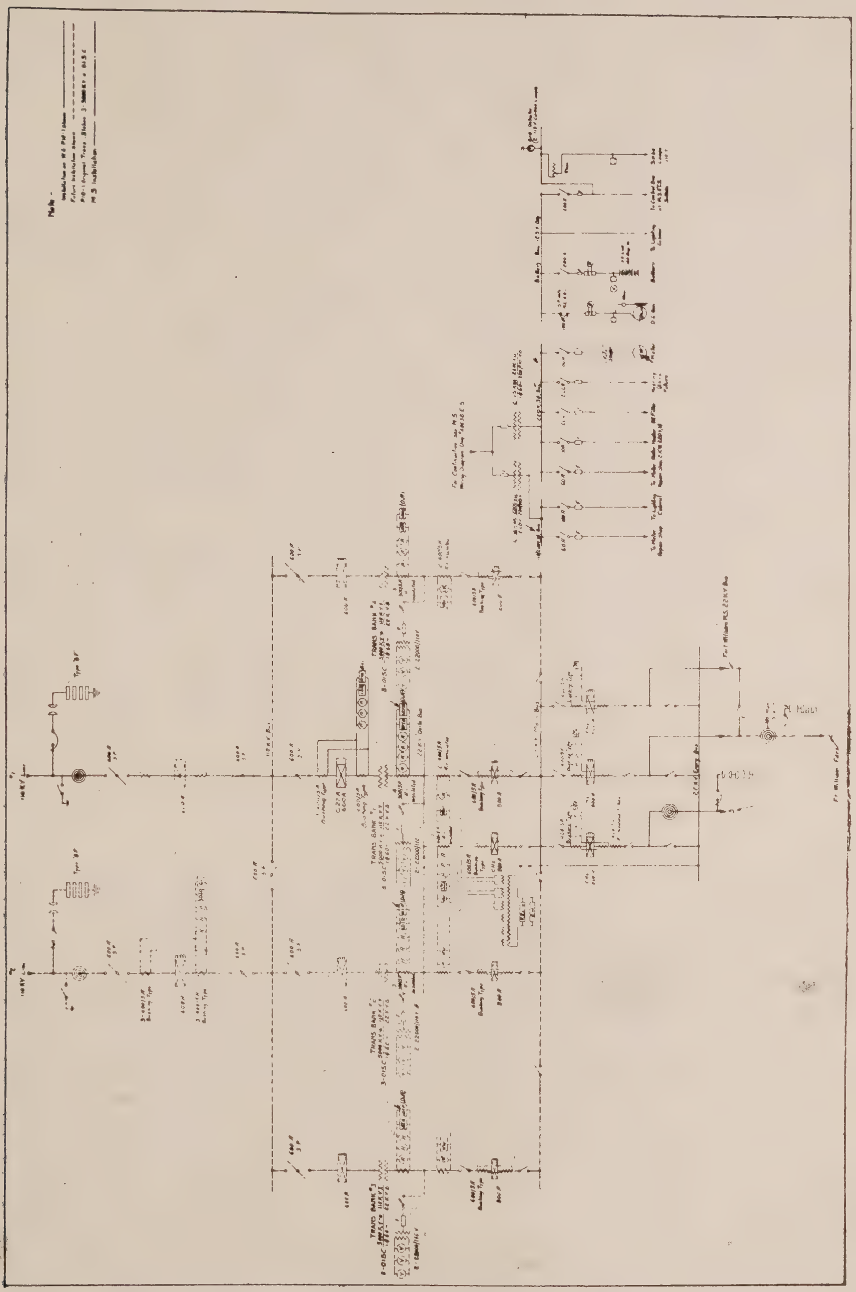
An emergency 110 kv. connection has been erected so that the spare 5,000 kv-a. transformer can be quickly connected in on any of the three phases by means of jumpers whenever necessary and so replace any transformer without the necessity of interchanging transformers. The secondary side of the spare transformer can be connected to the



Transformer Installation; 3-5000 kv-a., 60 cycle, 1 phase, 63,500 volt Y, 22,000 volt delta, radiator type.



Cross Section and Plan of Transformer Station.



Transformer Station Wiring Diagram.

22 kv. delta bus by means of jumpers made up and stored in the station.

The relay protection of the transformers consists of a balance arrangement of inverse definite time relays supplied from air insulated current transformers in the 22 kv. delta connections. The entire 22 kv. connections and bus bars are supported on an outdoor galvanized steel structure erected on concrete foundations. The 5,000 kv-a. transformers, breakers and lightning arresters are mounted on concrete foundations.

The 22 kv. layout consists of a main and emergency bus, one emergency bus feeder and three outgoing 22 kv. feeders. These feeders are controlled by 33 kv. 600 ampere full automatic breakers with ample rupturing capacity to meet the requirements of future developments on this system. On two of the 22 kv. feeders, lightning arresters have been installed. The entire station is controlled electrically from the switchboards located in the control room of the Municipal Station which also houses the entire station service equipment including a 60 cell storage battery, battery motor generator set, totally enclosed all metal service switchboard, oil storage tanks, filter press and oil pumps. Oil drain and filtering connections have been run to the transformers, also oil supply pipes to the outdoor oil circuit breakers.

The multi-conductor lead covered cables for the control, metering and station lighting connections are run from the outdoor transformer station to the control room of the substation underground in fibre ducts embedded in concrete.

The entire 22 kv. load from the station is recorded by solenoid operated graphic meters and a polyphase watthour meter.

The station property is enclosed with a 6 foot chain link fence with necessary gates. The grounds will be finished off in the Spring of 1927 with crushed rock, in the immediate

Fort William Municipal sub-station.

vicinity of the electrical apparatus and structures, and with lawns and evergreen shrubs on the surrounding area. Paths and roadways of crushed rock will also be laid where necessary.

A store house constructed of sheet metal has been erected on the station property for the storage of station and transmission line maintenance equipment.

Municipal Substation

The Municipal Substation building is erected of variegated cordoroy brick with lime stone facings. The foundations are of concrete. The floors are of concrete supported by structural steel with the exception of the motor generator set room, the floors of which and also the motor generator set foundations are erected at ground level. The interior walls are plastered and both walls and floors painted throughout. The name of the station is the "Hydro Electric Station Walsh Street" which wording has been carved in the limestone slab over the main entrance.

A galvanized steel structure is erected in rear of the station on concrete foundations on which is mounted the entire 22 kv. bus work, sectionalizing switches and air break switches.

The present station consists of three 3,000 kv-a. three phase outdoor type 22,000 volt delta to 2,300 volt delta 4,000 volt Y, 60 cycle, oil insulated self-cooled radiator type transformers which are filled with oil having a freezing point of 40° cent. Tap changers are also provided on the primary connections. These transformers are installed on concrete foundations in the outdoor 22 kv. structure adjoining the building. Eight outgoing 2,300 volt power feeders are included, also six constant current transformers with outgoing street lighting circuits and one mercury arc rectifier set with outgoing feeder. 1-500 kw. and 1-1000 kw. motor generator set for street railway service, complete with necessary automatic and protective a-c. and d-c. equipment, including three outgoing d-c. positive feeders are also included in this station. The same station service equipment used for the 110 kv. transformer station, also serves the substation, the whole of which is supplied with power by a feeder off the 2,300 volt bus protected by expulsion fuses.

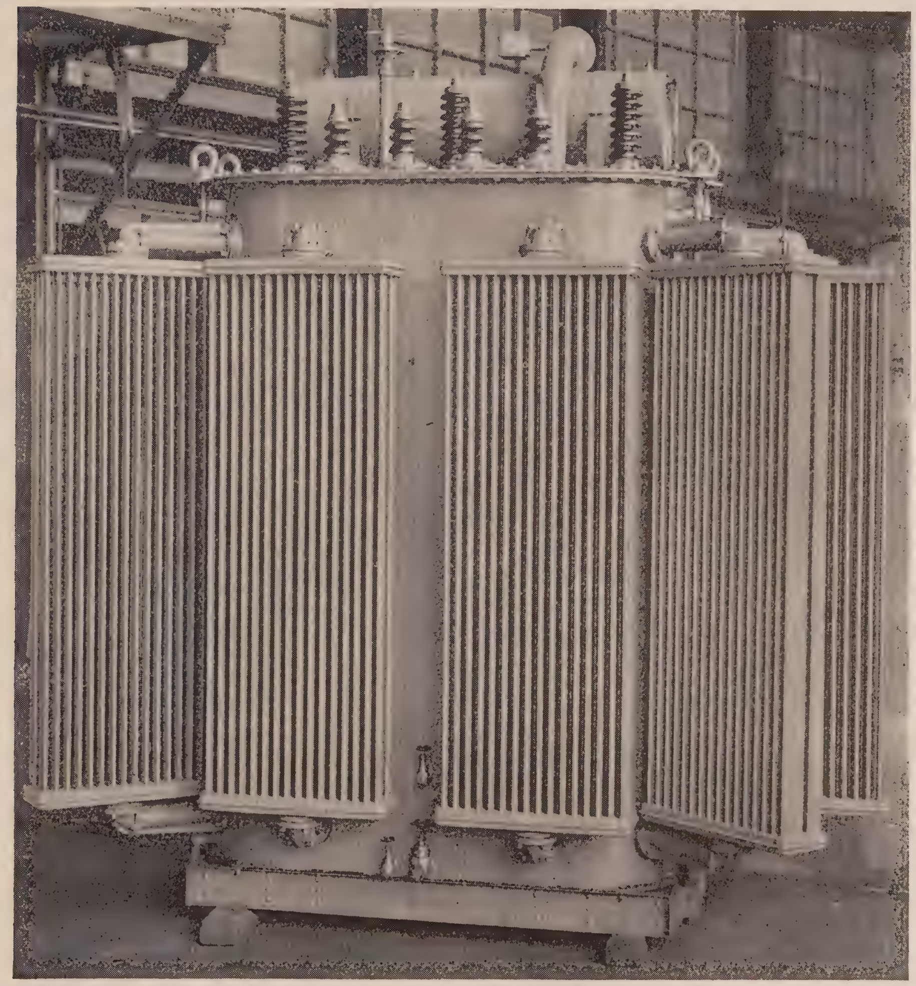
The ultimate station is designed for four 3,000 kv-a. 3 phase, self-cooled transformers and four additional outgoing 2,300 volt feeders. Provision has also been made for additional street lighting and street railway equipment with necessary outgoing feeders.

The 22 kv. main bus on the outdoor structure of the substation is fed direct by the No. 1 feeder from the transformer station. The No. 2 feeder from this station direct to the city load can also be connected to the substation bus through disconnecting switches in case of an emergency.

The three 3,000 kv-a., 3 phase transformers are connected to the main 22 kv. bus through air break disconnecting switches gang operated by remote control mechanism from the ground.

Three current transformers are inserted in the primary delta con-

Plans and Sections, Municipal Station.

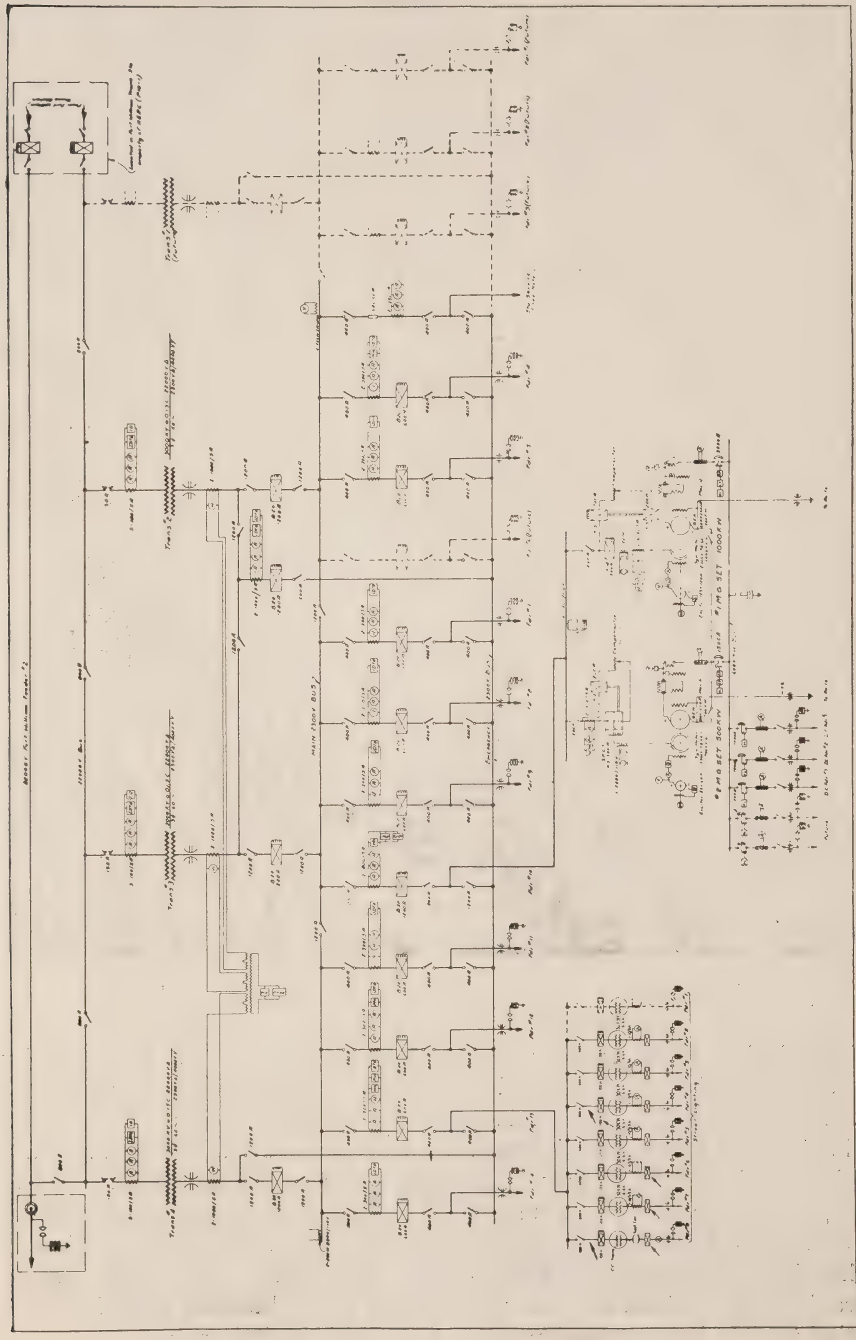


3,000 kv-a. radiator type Transformer, 22,000/2,300 volt delta.

nections inside each three phase transformer, which in conjunction with inverse definite time relays provide balance protections for each transformer in case of any fault developing in same. These relays are connected to open the feeder breaker in the transformer station controlling the substation in the event of trouble in the transformers, overload protection is taken care of separately by relays supplied by bushing type current transformers in the feeder breaker.

The 3,000 kv-a. transformers are connected 22,000 volt delta to 2,300 volt delta at which secondary voltage power is taken into the station building by single conductor cables through the building wall into the 2,300 volt switch room.

Each power transformer is con-



Municipal Sub-station Wiring Diagram.

nected to the main or the emergency 2,300 volt bus as required, in the switch room of the station through an automatic electrically controlled oil circuit breaker. The 2,300 volt connections are arranged so that either of two 3,000 kv-a. transformers can be connected separately to the emergency 2,300 volt bus. The outgoing feeder circuits are also arranged to be operated off the emergency bus through disconnecting switches or off the main bus controlled by a full automatic electrically operated oil circuit breaker.

The third 3,000 kv-a. transformer can be connected directly to the emergency bus also through disconnecting switches if required. The entire station layout is designed for 4,000 volt grounded neutral service in case it is desired in the future to operate at this voltage. Space has also been provided for the future installation of induction voltage regulators.

The entire 2,300 volt load is totalized on graphic wattmeters, each outgoing power feeder is equipped with indicating meters with provision made for future installation of recording meters if required at any time.

The load supplied to the street railway motor generator sets is recorded by a special graphic wattmeter and a watthour meter, indicating meters are also installed. The same also applies to the feeder supplying the street lighting equipment.

The control room of the station contains the control and relay boards for the transformer station, control and relay board for the substation, the control and feeder switchboard for the street railway and station service board. The floor of the control room has been covered with heavy linoleum.

The two street railway motor generator sets are three bearing sets, having synchronous motors driving the d-c. generators. Direct connected exciters are attached to the motor shafts. The a-c. and d-c. switching equipment is arranged to start the sets from either alternating or direct current and for operating the sets in parallel.

The street railway motor generator sets complete with a-c. and d-c. switching were moved over from the former location in the car barns. The a-c. and d-c. switching has been overhauled and redesigned, the a-c. equipment being changed from manually operated to electrically operated.

Four constant current transformers and one mercury arc rectifier set were also moved into the new station from the old substation, the switching and metering equipment for same being remodelled. The entire street lighting equipment is installed in the basement of the station.

All outgoing 3 phase, 2,300 volt power feeders, the single phase series street lighting and d-c. feeders are run in lead covered cables underground from the station in fibre ducts embedded in concrete, to the manholes below ground on Walsh Street, then up the terminal pole located at each of the three manholes to the overhead distribution system.

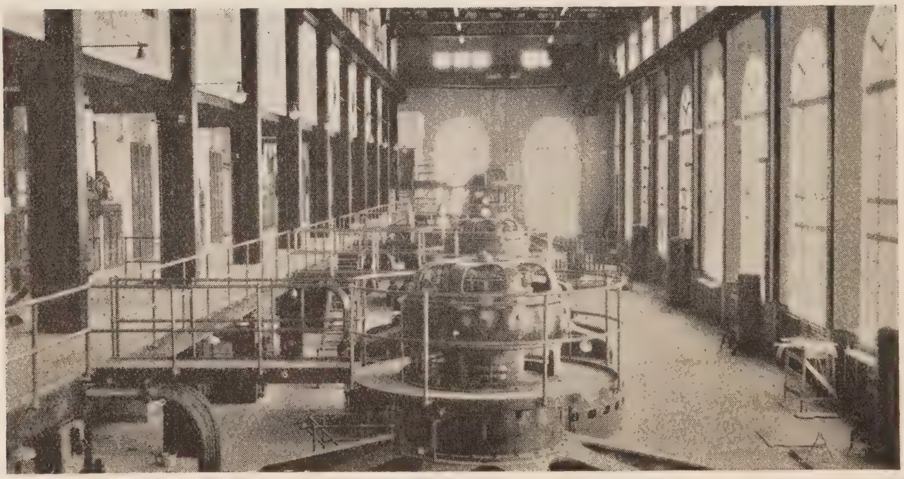
The station is heated with a hot water system, the boiler for same

being located in the station basement.

A meter repair shop is included in the station, also an office for the operating staff. Modern plumbing has been installed throughout.

The grounds in vicinity of the station will be finished in the Spring of 1927 with crushed rock under the outdoor 22 kv. structure, also roadways and walks surrounding same will be laid as well as lawns with evergreen shrubs. A six foot chain link fence has been erected around the substation property, which joins up with the fence of the transformer station.

Both the 110 kv. transformer station and the substation were placed in service on December 8th, 1926, on which date Mr. C. A. Magrath, Chairman of the Hydro Electric Power Commission of Ontario, at a function held in the Auditorium of the City Hall, Fort William, and described elsewhere herein, operated the control button which transferred the power from the Kaministiquia Power Company to the new stations initiating Fort William into the great family of Municipalities served by the Hydro Electric Power Commission of Ontario.



Nipigon Generating Station, Interior View.

Application of Hydro-Electric Power to Farm Work

Article No. 5.

THIS article treats of the installation on a farm in Waterloo Rural Power District where the uses are metered separately. Mr. Jonas Snider, north of Waterloo on the Provincial Highway, installed electric service in 1914. There are three kinds of use of the service,—lighting of all the buildings, domestic appliances, small power which consists of a 5 h.p. motor providing power to drive a line-shafting, as well as the uses of the syndicate outfit on this place. The installation consists of:—

In the House:—

1—75 watt nitrogen filled lamp........
16—25 watt tungsten lamps............
5—40 watt tungsten lamps............
2—60 watt tungsten lamps............ 795 watts
1—½ h.p. motor in woodshed for pumping.............. 373 watts
1—Electric Iron...... 600 "
1—Washing Machine.. 186 "

In the Barn and other Buildings:—

1—60 watt tungsten lamp............
5—40 watt tungsten lamps............
1—75 watt nitrogen filled lamp in mow
1—60 watt lamp in drive shed........
2—40 watt lamps in chicken pen....... 475 watts
1— 5 h.p. motor in barn............. 3,730 "

In the Yard:—

1—60 watt tungsten lamp............ 60 "

6,219 watts

Fig. 2. Buildings on Farm of Mr. Jonas Snider with Power Lines serving them.

The class of service taken is No. 5; the rate,—service charge, \$5.20 per month, 4 cents per kw-hr. for the first 70 kilowatt hours used in any month, and 2 cents per kw-hr. for the balance with prompt payment discount of 10 per cent.

The net cost and consumption for one year, are given below:—

as one horsepower output, amounted to only ten hours' use at full load. This motor supplies power for all of the chopping for this farm, which by the way, is as large as the average in the district, pulping of roots, pumping of water for the cattle, separating cream, and driving the emery-stone indicated in Fig. 2.

CONSUMPTION

Month	Lighting all Buildings and Domestic Uses	Small Power	Threshing and Silo Filling
January	73 kw-hr.	30 kw-hr.	220 kw-hr.
February	90 "	30 "	...
March	61 "	40 "	...
April	50 "	40 "	...
May	61 "	30 "	...
June	69 "	30 "	...
July	48 "	40 "	...
August	51 "	50 "	...
September	34 "	25 "	...
October	60 "	20 "	142 "
November	85 "	20 "	...
December	79 "	20 "	196 "
	761 kw-hr.	375 kw-hr.	558 kw-hr.

Service Charge—\$5.20 x 12		\$ 62.40
	1,387 kw-hr. at 4c.	55.48
	307 " at 2c.	6.14
	1,694	\$124.02
		12.40
		\$111.62

The uses on this place are not large but supply all of his power needs. The greatest use of the 5 h.p. motor in any month, was in August, and assuming one kilowatt in-put

The uses of the syndicate motor were confined to three months, December and January probably being winter threshing, and October, silo filling.

Fig. 2. Line Shaft from motor in stable driving pump, emery wheel and Cream seperator.

The capacity of this barn for cattle, is about twenty-five stalls, the output of the farm being in the form of milk.

There is a novel feature found in most of the farms using power in this district, that is, the use of power in the kitchen. Apparently for reasons of cleanliness, the kitchen or a part of it on some farms, is used as a dairy-room, and the power drive for this purpose is similar to that shown in Fig. 3, photo of which was taken on adjacent farm. It is to be noted that this power is usually a one-half horsepower or one horsepower motor belted to a line-shafting which provides the drive for the cream separator, butter churning, and washing machine.

It was not possible for us to secure a photograph of the 5 h.p. motor on this farm. We are, however, submitting in Fig. 4, a picture of the set-up of a 3 h.p. motor on an adjacent farm. In this case, however, there is an additional use made of power, that of driving a milking machine. The cut shows clearly, the method of erecting the motor and applying the drive on the ceiling so as to leave the passage-way clear. This form of installation is made on many farms.

The farmers of Waterloo County were among the first to put in Hydro power; in this as in many other ways, being to the forefront in keeping pace with the times.

Fig. 3. Kitchen arrangement typical for the district; ½ or 1 h.p. motor belted to line shaft driving cream separator, churn or washing machine.

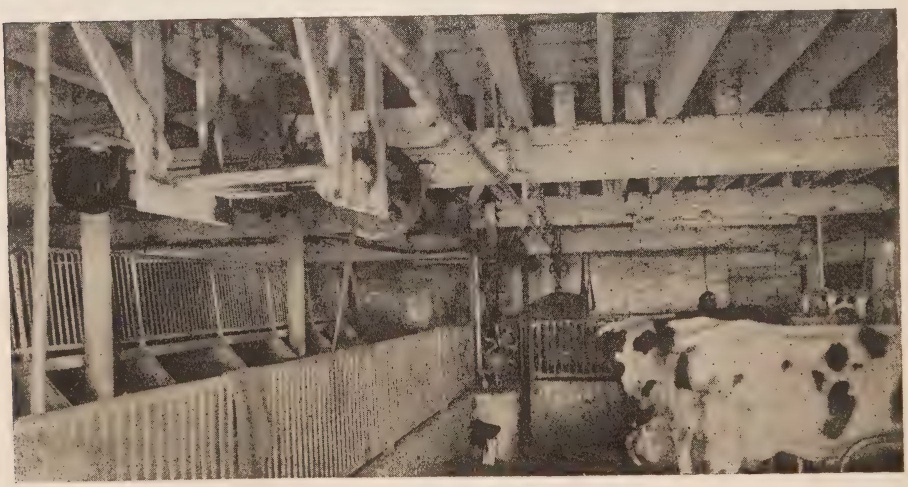


Fig. 4. Motor installation in barn.

Arlington:—Our Standard of Time

By F. K. D'Alton, Assistant Laboratory Engineer, H.E.P.C. of Ont.

THE Time Signals that are broadcast from the United States Naval Radio Station at Arlington, Va., are accepted as the standard of time over the larger part of the North American continent.

These signals are sent out twice each day, at noon and at 10 o'clock p.m. Eastern Standard Time, on the wave length of 2,653 meters, 113 kilo-cycles.

It will be readily realized that a reliable time standard, so easily available, is a very desirable means of checking time pieces at the individual transformer stations scattered over an extensive power system, and by keeping the clocks finely regulated, the reports of trouble, or of switching will agree very closely in the matter of the time of the occurrence.

When guided wave radio equipment was first installed on the Niagara System of the Commission to operate on the wave length of 1,570 meters, the tuning circuits of the receivers were so designed as to receive also the direct radiations of the Arlington station on a longer wave. The high tension transformer stations then received these signals individually and adjusted their own clocks.

Later when a change was made in the receivers to give them a lower range, the time signals could not be received as before. It then became necessary for the central station at Dundas to receive the signals on a broadcast transmitting aerial and long wave receiver and to relay the signals over the private telephone lines during the five minute periods in which they are sent.

Special Time Signal Receivers

This method is still in use and has been very satisfactory but the Commission have recently developed a self-contained long wave receiver with very simple control and using dry cell tubes and dry batteries throughout. It is intended that receivers of this type shall be installed at generating and transformer stations on the different power systems and be used only for time signal reception.

A front view of the receiver is shown in Fig. 1. On the panel appear only the dial of a variable condenser, the filament switch, the phone tip jacks and the small knob

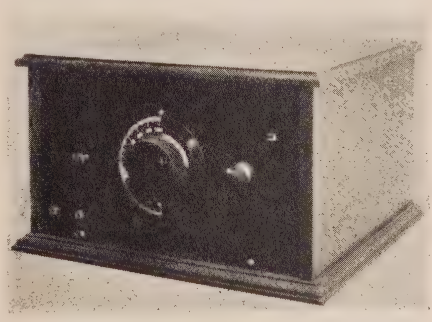


Fig. 1. Time Signal Receiver. Front view, showing simplifiid control.

used for control of regeneration. The tips on the phone cords are pushed into the phone tip jacks, and the filament circuits closed by means of the switch: the station is then found with the variable condenser and the signals brought up to maximum intensity by the regeneration control.

The illustration of Fig. 2 is intended to serve as a top view of the receiver and also as a wiring diagram when renewing batteries. The receiver consists of a regenerative tuning circuit for heterodyne reception, i.e., by beat note,—a detector, and only one stage of audio frequency amplification.

Aerial and ground connections are made to binding posts so marked at the rear. For the long waves of Arlington a large aerial is necessary.

The three inductances, L_1 Primary, L_2 Secondary and L_3 Regenerative coil,—are placed on an insulating tube with L_3 moveable by

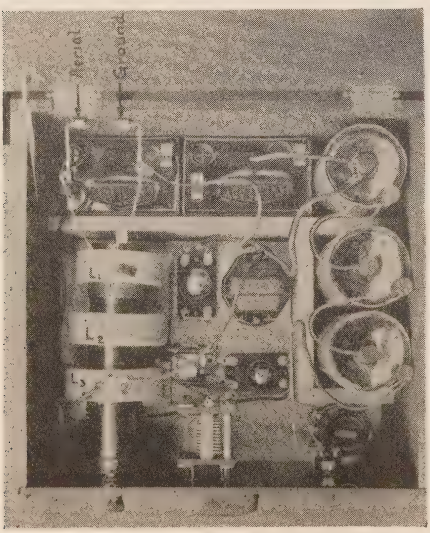


Fig. 2. Top view of Time Signal

means of the knobs on the front panel. By sliding coil L_3 along the tube the strength of regeneration may readily be controlled. This type of receiver is proving very convenient. It may be placed in the control room or office where the clock is within sight and allow a ready and accurate check twice each day. Furthermore as it is used for such short periods, the depreciation of tubes and batteries is very slight.

Recording Arlington Signals

The recording of time signals direct from the Arlington station was accomplished at the laboratories about two years ago, and a description of the method used was given in the April, 1925, issue of the Bulletin.

Audio frequency tuning, or sound resonance, enabled clear signals to be received in spite of considerable static interference which was present.

One of the tapes on which the signals were recorded is here shown in Fig. 3.

The Origin and Mission of Arlington Station

The United States Naval Observatory was originally established for the service of the Navy and the Merchant Marine and it was in order to furnish a guide for navigation that time signals were first sent out.

The first signal, outside of Washington, was the dropping of a time ball at New York. This was done automatically by means of telegraph wires from the Observatory at Washington, and although there was an

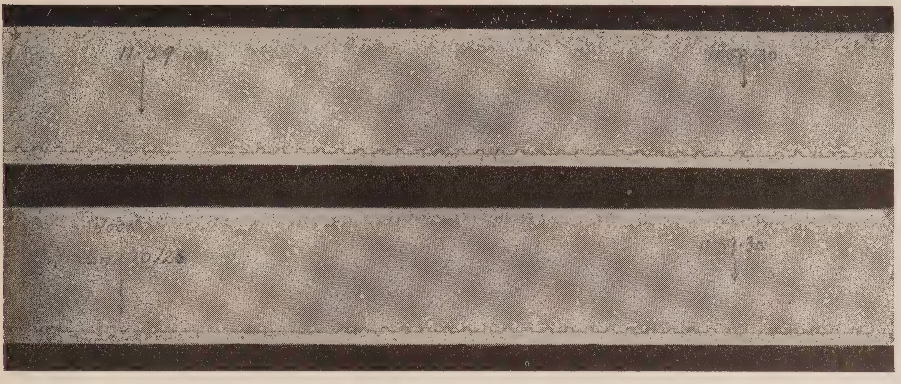


Fig. 3. Tape Record of Time Signals (Read Right to Left).

appreciable error, through loss of time in this method, the accuracy was sufficient for maritime purposes.

Later, however, a demand for time signals on land necessitated the distribution of time ticks throughout the country by the use of the commercial telegraph lines.

The construction of the great radio stations at Arlington, Va., and Annapolis, Md., made possible the broadcasting of time signals for both land and sea, with an accuracy never before obtained, thus radio rendered possible the scientifically accurate time signals so widely used to-day.

Equipment

The equipment at the Observatory for accomplishing the broadcasting of the time signals consists mainly of the following:—

(a) For Astronomical Calculation.
- Three standard clocks.
- Transit Telescopes.
- Chronographs.

(b) For Check and Transmission of Signals.
- The standard clocks.
- Two special transmitting clocks.
- Chronographs.
- Switchboard for relaying signals.
- Arlington broadcasting radio station.
- Radio receiving set for checking.

The Three Standard Clocks

The standard clocks were manufactured by the Rieflers, clock makers of Munich, and have an unusual form of escapement in that nothing touches the pendulum rod itself, the driving impulse being imparted through the suspension springs which support the weight of the pendulum.

These clocks have proved to have superior time keeping qualities. They are mounted individually on heavy concrete pillars and, in order to secure the greatest possible uniformity of rates, they are sealed in a partial vacuum and maintained at a constant temperature in a double-walled underground vault.

They are electro-magnetically wound and are provided with electrical connections for operating the recording chronographs in the transit rooms and in the time signal transmitting room.

Siderial time is kept by these clocks,—i.e. 366.24 days per year,—and, since the corrections and rates are accurately known, they are left undisturbed, being set only when repairs have been necessary.

Transit Telescopes

The corrections and rates of the standard clocks are established by observations of known stars during the Meridian passage. The special transit telescopes are used for the time observations.

These telescopes have been constructed with great rigidity and are mounted to rotate only in the plane of the meridian. Every precaution is taken to render these telescopes accurate, but they are never absolutely so, owing to temperature variations and other causes. Consequently it becomes necessary to apply carefully determined corrections to all observations.

The stars observed for time calculations are those which cross the Meridian near the zenith at Washington. As the earth rotates, the star passes through the field of view of the observer and its movement through a certain definite section of this field is recorded on the chronograph simultaneously with the ticks of the standard clock. Comparison of the chronograph records enables the determination of the exact time that the star passed the centre of the field, i.e., the time it crossed the meridian.

The recording of the movement of the star is done by means of a manually operated micrometer apparatus which causes interruptions of an electric current. These interruptions are recorded graphically by the chronograph.

The micrometer also controls a moveable vertical hair line within the telescope. With this hair line the operator follows the star through a part of the field definied by three fixed hairlines, the centre one of which is on the Meridian. The instrumental error must then be applied to the record to correct the recorded time of transit of the star.

The Transmitting Clocks

The two transmitting clocks are also of special construction and electro-magnetically wound. They are compared with the standard clocks before transmission of signals, and are set to the correct 75th Meridian time by means of magnetic devices acting on the pendulums.

These clocks are located in the transmission room, both being kept corrected and compared with the standard clocks by means of chronograph records.

The time signals are sent automatically through electrical connections to a relay on the switchboard. Telegraphic and radio control lines are operated by a wheel in the transmitting clock, which electrically operates a telegraph relay.

The Transmitting Switchboard

The switchboard in the transmitting room is connected electrically to the three standard clocks in the underground vault, to the two transmitting clocks, a chronograph, a radio receiving set, to the Naval Radio Station at Arlington, 12 miles distant, and to telegraph lines.

The Broadcasting Station

The time signal is broadcast at Arlington by a ten kilowatt vacuum tube transmitter using interrupted and modulated continuous waves on 113 kilocycles,—2,653 meters.

This transmitter is operated by remote control from the Naval Observatory. The control wire from the Observatory leads to a contro switchboard at the Radio Station[1] through which board by means of simple plug connections, any of the various government departments are able to operate any of the radio transmitters at this station.

The control wire operates an ordinary Bunnell telegraph relay, which in turn operates a transmitting relay on the desired radio transmitter.

Operation of the System

After being compared with the standard clock before each signal, by means of the chronograph, the transmitting clocks are set to the correct time by means of the magnetic devices on their pendulums. The signals are then sent automatically.

From 11.55 a.m. to 12.00 noon and from 9.55 p.m. to 10.00 p.m. Eastern Standard Time, dots are sent out each second, except at the 29th second of each minute and the last five seconds of each minute. Just prior to the hour there is an omission for ten seconds and the beginning of the hour is indicated by a long dash,—followed very soon by weather reports.

In all cases the beginning of the dots and dashes occurs at the beginning of the second.

The Accuracy of Arlington

Although the operation of this signal is automatic, it is not absolutely instantaneous. The lag between the clock ticks and the radio signals, however, is too small to be of any importance for commercial or navigational purposes, but it is a detriment for scientific purposes and the exact amount has to be determined.

The measurement of the time lag is made on the same chronograph that is used for comparison with the standard clocks. A radio receiver, located in the transmitting room, is arranged to operate a relay and make a simultaneous record on the chronograph sheet with the record of the outgoing signal on the control line to Arlington radio station. This makes it possible to measure directly the time required for the impulses to go to the radio station by wire, return through the air and actuate the receiving set. By subtracting the known lag of the receiver, the lag of the sending station is determined.

The time lag of the Arlington station is recorded daily and, although variable, it lies between .08 and .09 seconds.

Thus the whole time signal is automatically sent, automatically received and automatically recorded so that a graphic record is available. This record is subsequently examined and measured in order to determine the exact error of the signal.

Applications of Standard Signals

The time signals sent out from Arlington are received at many points and are used as standard of time in many applications.

The knowledge of the correct time is essential to ships at sea in order that the navigator may calculate his position on the ocean. These ships once had to depend on their chronometers when away from land, but they are now able to receive time signals frequently and make comparison between their chronometers and the correct time as transmitted by radio.

The service that was inaugurated for the purpose of supplying the sea going ships with correct time before leaving port has expanded until it is now possible for Navigators on both oceans, even as far as Australia, to receive accurate time signals daily.

The signals are also valuable to engineers in many locations when they are out of touch with civilization, as, for example, a survey party at a long distance from a town or railroad. The signals are a means of checking the portable chronometers, the indications of which are used in important astronomical calculations of bearings and other necessary data.

There are numerous applications, not only in isolated locations but even in the town or city where the signals are relied upon for their accuracy or used on account of their convenience of obtaining them. The applications made by the Commission are chiefly for the purpose of synchronizing the time pieces in the different transformer stations, a condition which is of extreme importance.

Note: In the above article, the information relating to the checking and broadcasting of time signals from Arlington has been supplied to the writer by the United States Navy Department, Bureau of Engineering, with permission to publish.

Electrical Refrigeration, Help it Help You

By G. E. Durban, Delco-Light Company.

ELECTRICAL refrigeration in its present state is a mechanical rather than an inventive accomplishment, for just as there were hundreds of flying machines before the Wright Brothers built one that would fly, so were there hundreds of ice machines and mechanical refrigerations before a dependable apparatus was produced. I have been told they were working on this thing as far back as the time of Benjamin Franklin, and that that gentleman, who has been called the "Father of Electricity", was much interested in the proposition, but that he finally came to the conclusion that, while the idea was a fine one, it was too impractical and too expensive to ever be perfected.

There were two big jobs to be done,—first to produce a machine so well thought out, so perfectly made, that it could be installed in the user's home with a guarantee of dependability and service, and second, to produce a machine at a price which would permit a satisfactory volume of sales.

This has been accomplished, completing the job the inventors started many years ago; in so doing we have introduced another piece of mechanical equipment in the home in a conspicuous service. We are helping to establish a new idea in the American home—the idea of plant equipment—we are helping to bring a new psychology into the household, for the old idea in housekeeping has been that servants or members of the family did the work with the help of a few tools, just as men used to do the work in the factories,

In addition to the vast field for electrical refrigeration in the household, the field for small commercial units is a very large one; it includes soda fountains, meat markets, groceries, restaurants, cafeterias, hotels, clubs, delicatessens, etc.

The application of these small commercial units for cooling drinking water in factories, office buildings, department stores, restaurants, etc., also opens up a wide field.

The mechanically refrigerated ice cream cabinet is one of the greatest developments in the ice cream industry in the past ten years; almost every ice cream manufacturer of any size in the United States is today either using these cabinets or is contemplating the use of them.

It is also interesting to note the various applications of electrical refrigeration units for apartment house installations.

The features of convenience, dependability and economy, which characterize electrical refrigeration, bring manifold advantages to the owners and tenants of residential apartments.

One of the biggest jobs of the public service companies with regard to mechanical refrigeration, and the only job of the non-merchandisers, is the sale of the idea of electrical refrigeration. They have a splendid

opportunity because of their position as utilities and because of their relations with their consumers, to promote the idea of the benefit of electrical refrigeration.

In taking on the sale of electrical refrigeration it is of great importance that the public utility company select an apparatus which has been well tested; which has been produced by a reputable, well financed company which has a reasonable expectancy of being permanent.

The public utility company can do a great deal toward promoting the electrical refrigeration industry, which is bringing to them one of the best loads they have ever had on their line, even if the utility does not merchandise. It can run advertising of a general nature, advising the use of electrical refrigeration without reference to any make or model.

2. Utility companies can send out folders or pamphlets with the monthly statement made to lighting customers. These pamphlets, of course, in the case of the non-merchandising companies would not be confined to one make of electrical refrigerator.

3. The lighting companies who do not merchandise could show on their display floors suitable models of apparatus which had passed their tests.

There are a few ways in which the sale of electrical refrigeration can be handled.

1. The public service company can perform the functions of selling, serving, and financing, in which case it would be necessary for them to maintain a trained service organization for installing and taking care of the product after it is sold.

2. Where the manufacturer has established an organization in the field, the public service company can limit their responsibility to selling, in which case the manufacturer's organization is prepared to service, and in some cases to finance the sale.

Merchandisers of refrigeration apparatus should run a refrigeration department as a separate unit, because it has been found that very little refrigeration apparatus is sold by simply drawing the whole force of appliance salesmen into the sale of refrigeration apparatus. This is because the sale of this type of specialty requires very special training of salesmen.

A great deal of good can be accomplished through contact with architects and builders by bringing to their attention that a new house should have electric outlets for mechanical refrigeration put in at the time the house is built.

Finally, I call to the attention of the utility men the fact it is of paramount importance that service be reasonable in price, quickly given, and thoroughly done. The greatest deterrent to sales in any locality is brought about by inadequate and inefficient servicing.—*Electric Light and Power.*

An Appreciation

That the service rendered by the Commission in rural districts is appreciated, is borne out by the following unsolicited letter from Mr. C. A. Sharp, of Hathaway, Montana, Proprietor of the Washington Hotel, a small summer hotel located on the St. Clair River at Port Lambton, Ont.

The letter is as follows:—

Hathaway, Montana,
Nov. 13th, 1926.

Hydro-Electric Power Commission
of Ontario.
Toronto, Ont.

Dear Sirs:—

Mrs. Sharp writes me how much she appreciates your service. Has just closed a wonderfully prosperous season and will join me here soon.

We will go to the "Washington" together May, '27. Personally, I have not been at the "Washington" since your service was installed. We wish we could tell the whole United States what you have done for us.

Yours very truly,
(signed) C. A. Sharp,
Agent, Northern Pacific Ry. Co.
Hathaway, Montana.

Resuscitation From Drowning

A report has been received by the Commission regarding an incident where a life was saved due to the general policy and practice of the prone pressure method of resuscitation, among its operating employees.

F. O. Crich.

The incident occurred on the evening of August 1st when one of the Commission's operating staff, Mr. F. O. Crich, at the Wasdells power plant was working around his cottage on the Severn River. He was attracted by hearing a girl calling for help from the other side of the river. The only persons he could see were three men sitting on the bank on his own side fishing. He ran down the river to where the men were and from that point could see a girl, 14 years of age, standing in the water up to her waist, and a boy, ten years of age, in the water up to his chin. Crossing the river on a bridge at this point, he saw the unconscious form of the boy's brother floating away with the under current about

two feet below the surface. The boy was in a horizontal position, face down, his legs drawn up in a sitting position and his arms somewhat forward and hanging limp. He appeared to be sinking while being carried away. Mr. Crich dove into the river from the bridge and succeeded in getting ahold of the boy and dragging him out of the water, which at that point was about 8 or 10 feet deep. He immediately commenced resuscitation and after working for about 15 minutes noted signs of life returning. He then carried the boy home and after about 45 minutes more work, he seemed to be more normal and on the way to recovery. Mr. Crich thereupon rubbed the boy down, covered him with a half-dozen blankets and left him in care of his family.

Had it not been for his training in resuscitation as taught and practised by the Commission, Mr. Crich doubts very much whether the boy would have been saved after having been removed from the water.

This is one instance of the saving of life carried out by knowledge of resuscitation and ability in the emergency to act quickly. There have now been a number of lives saved by the action on the part of members of the Commission's staff who have received the training and are required to practice.

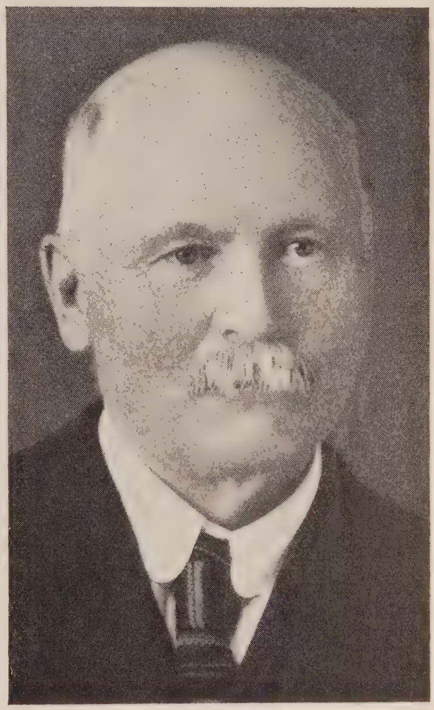
Others of the Commission's staff have taught groups of girls and boys in the methods of resuscitation and these girls and boys have been the means of the saving of lives of companions from drowning.

Presentation of Resuscitation Medal

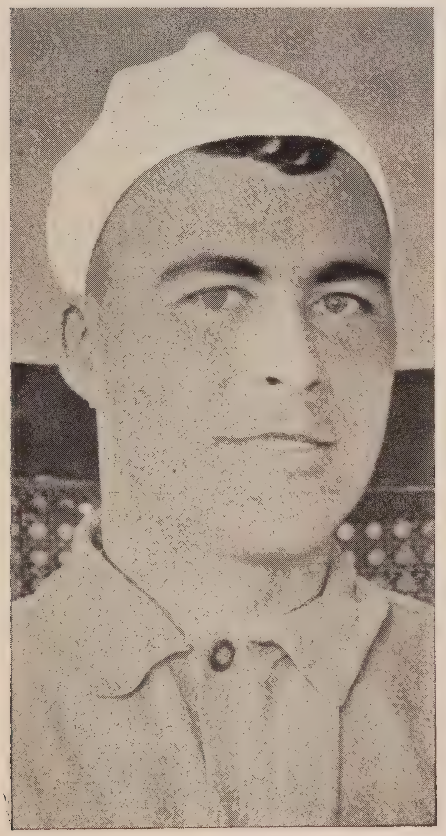
Late in the afternoon of May 21st, 1926, Mr. Douglas Ellis, one of the operating staff of the Eugenia Power House, started in to clean one of the windows and in doing this, his head came in contact with a 26,000 volt bare lead from a bank of transformers to the bus bars. He fell backwards and became unconscious and stopped breathing. By the training and resourcefulness of the whole operating staff of the Eugenia Power House, power was cut off, the man was cleared, resuscitation

Resuscitation Medal presented to Eugenia Operating staff.

was started, a doctor was brought down a very bad hill in extremely bad weather and by their combined efforts Ellis began to breathe. The injuries that he received were of such a character that it was impossible to move him excepting to the nearest house and nurses were brought in to look after him. During this time, long distance communication had been early set up with Toronto and the best advice possible was given over the telephone; finally after a few days he was moved to Toronto General Hospital where he has been, up to the present, receiving treatment.



Dr. Angus Ego, the first doctor to treat the patient.

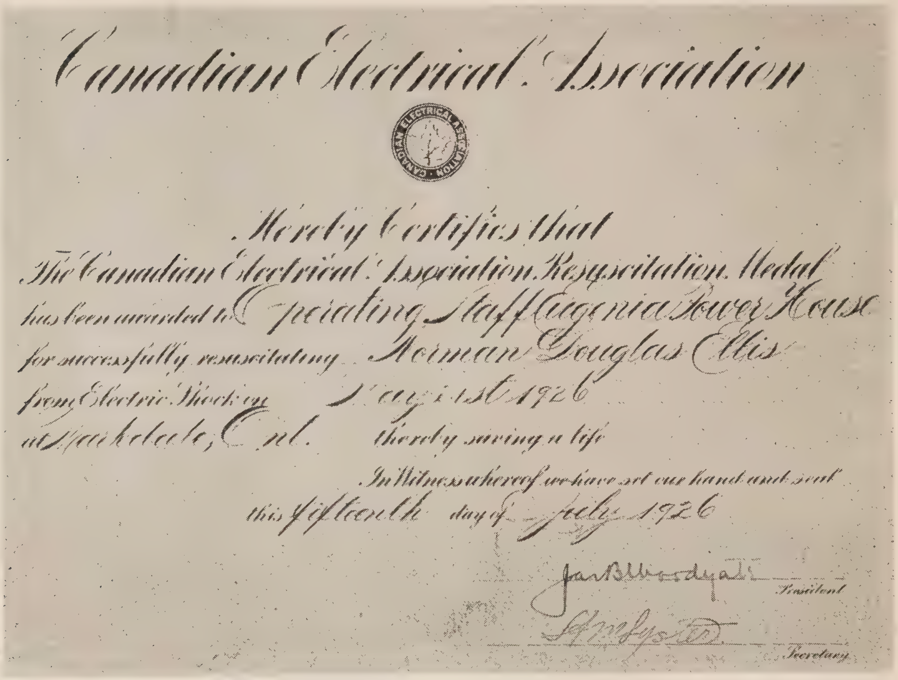


Douglas Ellis.

It is a rather simple story but shows conclusively what training and resourcefulness on the part of the men closest to an accident will mean in the saving of life.

A report of the matter was made and the Canadian Electrical Association awarded to the operating staff of the Eugenia Power House, the Canadian Electrical Association Resuscitation Medal and Certificate, and on October 20th these were presented to the staff in the presence of a number of friends at Eugenia Power House.

In going up to Eugenia to make the presentation, Mr. Wills Maclachlan, representing the Canadian Electrical Association, was asked by Douglas


Canadian Electrical Association

Canadian Electrical Association

Hereby Certifies that
The Canadian Electrical Association Resuscitation Medal
has been awarded to Operating Staff Eugenia Power House
for successfully resuscitating Norman Douglas Ellis
from Electric Shock on May 21st 1926
at Markdale, Ont. thereby saving a life

In Witness whereof we have set our hand and seal
this fifteenth day of July 1926

Jas B. Woodyatt President

Secretary

Certificate accompanying Resuscitation Medal.

Ellis to take a letter to them. The simplest way to present this case is to let the letter speak for itself:—

To my Noble Pals at Eugenia Plant, H.E.P.C.

Dear Friends and Fellow Workmen:
Through the lines of the following I wish to convey, in a humble way, my deepest gratitude for the successful efforts set forth in resuscitating me and saving my life, May 21st, 1926, and I fully realize that were it not for the alertness, coolness and persistence of my associates at that critical time it would not be necessary

Part of the Operating Staff, Eugenia Power House.

for me to send this message at this time.

I wish to offer my sincerest congratulations to those heroes individually for their successful work.

I wish to state that at present I am feeling just like a two year old, and I don't mean egg.

I have the use of my eyes, arms, hands and legs and appreciate each and every one. Am progressing slowly but very patiently. My greatest desire at the present time is to hear that resuscitation is being preached and practiced in all the branches at Universities, and to the General Public, so that others may be saved by this great life restorer.

Your most grateful Pal,

D. Ellis.

Commissioner J. M. Brown, Carleton Place

On November 25th, Mr. J. M. Brown, a prominent citizen of Carleton Place, died after a life of much usefulness to the town and community. Mr. Brown was a member of the firm of J. H. Brown and Sons which for many years has carried on a flour-mill business in the town. They also developed the water-power in the town of Carleton Place on which the flour-mill is located, for the supply of electricity to the town.

In 1919, the Hydro-Electric Power Commission of Ontario purchased the power-house, which had been built by this firm, for the Rideau System, while the town of Carleton Place took over the distribution system. Mr. Brown has been on the Public Utilities Commission of Carleton Place since that time as Commissioner.

He was also manager and director of the Mississippi River Improvement Company. This Company has charge of the control dams along the Mississippi River, and the many industries operated by water-power from this river have benefitted greatly from his efficient handling of the river flow. Mr. Brown had many years experience with power development on this river and gave unstintingly of his time to the work of this Company.

Employees of the Commission who were brought in contact with Mr. Brown had a high regard for for him, and much regret his passing.

During 1925 the production of quartz (silica) in Canada was considerably higher than the total recorded in the preceding year. According to statistics issued by the Dominion Bureau of Statistics shipments of quartz during 1925 reached a grand total of 197,224 tons valued at $363,612 as compared with 150,896 tons at $323,156 shipped in 1924.

The production by provinces in 1925 follows:—

Province	Tons	Value
Nova Scotia	1,352	$ 6,760
Quebec	6,459	30,064
Ontario	188,560	324,526
British Columbia	853	2,262
Totals	197,224	$363,612

—*Natural Resources, Canada.*

Hydro News Items

Central Ontario System

In the Oshawa Rural District, the extension from Brooklin to Ashburn is now nearly completed, and further contracts have been received for the continuation of this line from Ashburn to the hamlet of Myrtle, a distance of three miles. This will be dealt with early in the spring.

* * * *

In the town of Oshawa, a new lease has been executed for a new office, which is in a better location and is more suitable than the old building.

* * * *

In Belleville the Local Manager is now installed in the new premises in the main business district and reports a great increase in sales of merchandise owing to the favorable location of this new store.

* * * *

Niagara System

Hydro power was first supplied to the village of Arkona on December 1, 1926. The village was formerly supplied by the Rock Glen Power Company from a small water power plant on the Ausable River. The distribution system of the Company was recently purchased by the Municipality and reconstructed by the Commission.

* * * *

A new rotary converter substation has recently been constructed in Windsor by the Commission for the operation of the Hydro-Electric Radials, Essex District. This station will have a capacity of 3000 kv-a., one unit of 1,000 kv-a. having already been put into service.

* * * *

Hydro service was supplied for the first time to Port Rowan on November 26, 1926, and Port Rowan and the Rural Power District, including St. Williams, will be supplied from a 26,000-volt substation which has been erected at St. Williams.

* * * *

On December 18, power was first supplied to the Police Village of Scotland. This municipality, and the adjacent rural districts, is being supplied over a 4000-volt line from Burford, a distance of approximately 9 miles.

* * * *

Ottawa System

Extension of a rural line has been completed to North Gower Police Village and service will be given also, in Osgoode and Kars before Christmas, by which date, the Nepean rural lines will be changed over to 8,000 volt primary in place of volts.

* * * *

St. Lawrence System

The 4,000 volt single phase line from near Apple Hill to Avonmore

to supply rural residents in the Township of Roxborough and residents of Monkland and Avonmore is completed.

* * * *

Thunder Bay System

While at the head of the Great Lakes to officiate at the turning on of Hydro Power from Nipigon to Fort William, a description of which is given elsewhere in this number, Chairman C. A. Magrath and Commissioner C. A. Maguire visited the Public Utilities Commission of Port Arthur. The meeting at Port Arthur was of an informal nature, the present power situation and plans for the immediate future being discussed.

Association of Municipal Electrical Utilities

The election ballot that will be submitted at the Convention of the Association at Toronto on January 19 and January 20, 1927, will show the following names as candidates for the various offices:

PRESIDENT—J. J. Heeg, R. L. Dobbin.

VICE-PRESIDENT—J. G. Archibald, A. W. J. Stewart.

SECRETARY—S. R. A. Clement.

TREASURER—G. J. Mickler, D. J. McAuley.

DIRECTORS (From the membership at large)—W. R. Catton, O. H. Scott, J. E. B. Phelps, V. S. McIntyre, E. V. Buchanan, F. C. Adsett.

DISTRICT DIRECTORS—

NIAGARA DISTRICT—H. G. Hall, J. G. Jackson.

CENTRAL DISTRICT—G. E. Chase, C. T. Barnes, V. B. Coleman.

GEORGIAN BAY DISTRICT—E. J. Stapleton, C. E. Brown.

EASTERN DISTRICT—R. J. Smith.

NORTHERN DISTRICT—T. W. Brackinreid.

Canada's mining industries showed continued progress in the first half of 1926 and production reports almost every field pointed to the establishment of new records during the present year according to a statement issued from the Dominion Bureau of Statistics. Valued at \$98,395,788 the output of metals and non-metallic minerals including coal, gas and oil, in the first 6 months of 1926 marked an advance of \$8,048,090 or 8.9 per cent. over the totals reported for the first half of 1925.—*Natural Resources, Canada.*

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in November, 1926.

Appliances

BRUNNER MFG. CO., Utica, N.Y.
Air Compressor, Cat. No. 931.

* * * *

SPENCER LENS CO., 442 Niagara St., Buffalo, N.Y.
Delineascope Projection Machines, Models M & E.

* * * *

THE DOVER MANUFACTURING CO., Dover, Ohio.
Coffee Percolator "Dover".

* * * *

DALYTE ELECTRIC LIMITED, Guelph, Ont.
Marcel Waving Iron "Dalyte".

* * * *

SUPERIOR ELECTRICS LIMITED, Pembroke, Ont.
3 lb. pressing irons, Nos. 3 & 4.
Immersion Water Heaters, 110 volts, 1000 watts and less, Cat. Nos. 102, 103, 104, 106, 107 and 108.

* * * *

BELLEVILLE ELECTRIC & STAMPINGS LIMITED, Belleville, Ont.
"Redi-Heat" portable electric hotplates, 110 volts, 10 amperes and less, Cat. Nos. 700, 700A, 701, 701A.

* * * *

WHITTAKER FIREPLACES, WINDSOR, Ont.
Mantel Grate, 110-220 volts, 3 wire, 3,000 watts, Cat. No. 95.

* * * *

*NU-WAY CORPORATION (Submittor), 2416 Fourth Ave., Rock Island, Ill.
DOOLEY-BRADEN CO. (Mfr.), 4520 Sixth Ave., Rock Island, Ill.
Type "D" Domestic Oil Burner.

* * * *

*WAPPLER ELECTRIC CO. INC., 162-184 Harris Ave., Long Island City, N.Y.
"Portable Telatherm", 660 watts, 110 volts, 60 cycles, a.c.
"Wyeth Endotherm", 6 amperes, 110 volts, 60 cycles a.c.
"Deep Therapy Water Cooling Device", 6 or 12 amperes, 110 or 220 volts.
X-Ray Apparatus, as listed on Underwriters' Laboratories Card dated January 12, 1926.

* * * *

*KLIEGL BROS. UNIVERSAL ELECTRIC STAGE LIGHTING CO., INC., 321 W. 50th St., New York, N.Y.
Arc Lamps, theatre spot lamp, 30 amperes, 125 volts, d.c., "Kliegl".

* * * *

*CADILLAC HOME APPLIANCES, LTD., 78 Duchess St., Toronto, Ont.
Hotplate, 1100 watts or less, 110 volts, Model Nos. 99, 100, 102.
Toaster, 5 amperes, 110 volts, Cat. No. 230.
Waffle Iron, 5.75 amperes, 110 volts.
Marking: "White Cross".

* * * *

*RACINE UNIVERSAL MOTOR CO.,

Bridge and Ontario Sts., Racine, Wis.

Portable Hair Dryer, 5 amperes, 110 volts.

Marking: Nameplate with rating and trade mark.

* * * *

*ROME MANUFACTURING CO., Rome, N.Y.

Portable Air Heater, 600 watts, 110-120 volts, "Rome".

* * * *

Switches

*JAMES H. BETTS, INC., 1391-95 Sedgewick Ave., New York, N.Y.

Motor-operated sign flasher machines. Brushes rated 200, 300 and 600 watts, 110 volts.

Thermo-operated flashers. 660 watts or less, 110 volts, "Flip Flop". Cat. Nos. 500-03 incl., 510-12 incl.

Marking: "Flash-O-Lite" and "James H. Betts, Inc."

* * * *

*HONEYWELL HEATING SPECIALTIES CO., Wabash, Ind.

Temperature Regulating Appliances, as listed on Underwriters' Laboratories Card, dated Sept. 10, 1926.

* * * *

Fittings

SMITH AND STONE LIMITED, Georgetown, Ont.

Mogul Base Sockets, 1500 watts, 600 volts, Cat. Nos. 1022 and 1023.

Cartridge Fuse Cutout Bases, 30 and 60 amperes, 250 volts, Cat. Nos. 1207B, 1208A, 1208B. 600 V., Cat. Nos. 1209 and 1210.

Plug Fuse Cutout Bases, 3 to 30 amperes, 125 volts, Cat. Nos. 1948 and 1949, 8042 and 2135.

Medium Base Sockets, 660 watts, 250 volts, Cat. Nos. 1017 and 1020.

Medium Base Receptacles, 660 watts, 250 volts, Cat. Nos. 1018A, 113A.

Receptacles for Attachment plugs and plugs, 10 amperes, 250 volts, Cat. Nos. 1105, 1103, 1110.

* * * *

Miscellaneous

*ELECTRAD, INC., 428-30 Broadway, New York, N.Y.

Lightning arrester of the air-gap type for indoor use. Type 100.

Separable radio plug for use in sockets or attachment plug receptacles to provide antenna connection for radio receiving sets. "Electrad Lamp Socket Antenna".

Marking: "Electrad".

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*These devices are under the Underwriters' Laboratories re-examination or label service.

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THE BULLETIN

VOL. XIV NO. 1

Hydro-Electric Power Commission of Ontario

JANUARY 1927
DECEMBER

Winter Conditions at Hanna Chute Development.

HYDRO MUNICIPALITIES

CENTRAL ONTARIO SYSTEM

	Pop.
Belleville	12,803
Bloomfield	625
Bowmanville	3,447
Brighton	1,375
Camden East Twp	2,982
Cobourg	5,459
Colborne	829
Darlington Twp	3,407
Deloro	298
Deseronto	1,928
Hallowell Twp	
Havelock	1,266
Kingston	22,368
Lakefield	1,146
Lindsay	7,840
Madoc	1,078
Marmora	853
Millbrook	733
Napanee	2,992
Newcastle	619
Newburgh	434
Norwood	711
Omemee	557
Orono	700
Oshawa	16,059
Peterboro	21,790
Pickering Twp	4,382
Picton	3,189
Port Hope	4,567
Richmond Twp	1,944
Seymour Twp	2,506
Stirling	778
Trenton	5,881
Tweed	1,268
Warkworth	
Wellington	850
Whitby	4,131
Whitby Twp	1,785
Whitby E. Twp	3,747
Total	147,327

GEORGIAN BAY SYSTEM

Alliston	1,301
Alton	450
Artemesia Twp	2,316
Arthur	1,218
Barrie	7,387
Beaverton	975
Beeton	580
Bradford	1,028
Brant Twp	
Brechin	255
Brock Twp	2,795
Cannington	896
Chatsworth	326
Chesley	1,803
Coldwater	663
Collingwood	6,237
Cookstown	635
Creemore	603
Derby Twp	1,507
Dundalk	690
Durham	1,622
Eldon Twp	2,047
Elmvale	600
Elmwood	350
Flesherton	417
Flos Twp	
Gamebridge	70
Grand Valley	595
Gravenhurst	1,621
Hanover	2,842
Holstein	285
Horning's Mills	350
Huntsville	2,316
Kilsyth	
Kincardine	2,156
Kinloss Twp	
Kirkfield	138
Lucknow	918
Mara Twp	2,280
Maraposa Twp	
Markdale	927
Meaford	3,000
Midland	8,060
Mount Forest	1,825
Neustadt	444
Nottawasaga Twp	
Orangeville	2,503
Oro Twp	
Owen Sound	12,360
Paisley	749
Penetang	3,896
Port McNicholl	614
Port Perry	1,142
Priceville	
Reach Twp	
Ripley	670
Shelburne	1,134
Stayner	927
Sunderland	570
Sunnidale Twp	
Tara	597
Tay Twp	
Teeswater	807
Thorah Twp	1,084
Thornton	200
Tottenham	453
Uxbridge	1,492
Victoria Harbor	1,462
Waubaushene	600
Wingham	2,470
Woodville	448
Total	98,685

NIAGARA SYSTEM

Acton	2,000
Agincourt	
Ailsa Craig	535
Alvinston	659
Amherstburg	2,820
Ancaster	400
Ancaster Twp	4,124
Arkona	400
Aylmer	2,241
Ayr	796
Baden	710
Barton Twp	7,774
Beachville	503
Belle River	580
Bertie Twp	
Beverly Twp	
Biddulph Twp	1,640
Blandford Twp	
Blenheim Twp	
Blenheim	1,528
Blyth	692
Bolton	656
Bothwell	630
Brampton	4,406
Brantford	32,786
Brantford Twp	7,301
Brigden	400
Brussels	872
Burford	700
Burford Twp	3,886
Burgessville	300
Caledonia	1,450
Canard River	50
Caradoc Twp	
Chatham	15,525
Chinguacousy Twp	
Chippawa	1,459
Clifford	
Clinton Twp	
Clinton	1,941
Comber	800
Copetown	230
Cottam	333
Courtright	425
Crowland Twp	
Dashwood	350
Delaware Twp	
Delaware	359
Dereham Twp	3,200
Dorchester	400
Dorchester S. Twp	1,436
Dorchester N. Twp	
Dover E. Twp	
Drayton	
Dresden	1,393
Drumbo	375
Dublin	218
Dumfries N. Twp	
Dumfries S. Twp	
Dundas	5,054
Dunnville	3,569
Dutton	870
Easthope N. Twp	
Easthope S. Twp	
Ekfrid Twp	
Elmira	2,400
Elora	1,199
Embro	463
Essex	1,753
Etobicoke Twp	15,000
Exeter	1,583
Fergus	1,815
Flamboro W. Twp	
Flamboro E. Twp	2,624
Ford City	11,301
Forest	1,386
Georgetown	2,554

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Growth of Hydro During 1926

By Charles A. Magrath, Chairman H.E.P.C. of Ont.

STEADY growth has characterized the work of the Hydro-Electric Power Commission during the past year, and it is a pleasure to my colleagues and to me to be able to assure the citizens of the co-operating municipalities that, from an engineering as well as from a financial standpoint, the operation of their great electrical undertaking continues to be most satisfactory.

During the past year there was celebrated the forty-seventh anniversary of the invention of the incandescent lamp by Thomas A. Edison. It is within the latter half of this period of forty-seven years that the efforts to furnish low-cost electrical power for the industries of Ontario were initiated, and resulted in the formation of the present "Hydro" undertaking, which has now developed into one of the greatest electrical power distributing systems of the world. The invention in 1879 of a practical incandescent lamp—inefficient though it was compared with later developments—stimulated the formation of small companies to distribute electricity. From these humble beginnings, step by step, have developed the great electrical power distributing systems of the world. Some of these have interconnected transmission and distribution lines aggregating thousands of miles, and ranking with the greatest of these is the system operated on behalf of Ontario municipalities by the Hydro-Electric Power Commission.

The increase in the world's output of water power during recent years has been phenomenal. It is noteworthy that the percentage increase of water power installations in the manufacturing countries of Europe has taken place at an even greater rate than in Canada and the United

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January, 1927

States. With commendable enterprise, Great Britain—where large water powers are not available—is modernizing her electrical power and distribution systems.

In Canada in the industrial field there prevails a spirit of hopefulness with respect to the prospects for the near future and this has been reflected in a greater demand for power for industrial purposes. The marked improvement that during recent years has taken place in methods of commercial lighting and the demand on the part of citizens for improved lighting of streets have resulted in an ever-increasing utilization of electrical energy for these purposes. In the class of domestic service, the growing recognition of the advantage of more generous lighting equipment, together with the rapid expansion in the use of electrical appliances, has further increased the annual per capita consumption of electrical energy in the homes. With the possible exception of Norway, where a large proportion of the electrical energy produced is used in certain basic chemical industries, the per capita consumption of electricity in Canada is now the highest in the world.

The modernizing of the industrial establishments of Europe through the greater use of electricity will undoubtedly mean keener competition in world markets for manufactured goods. The Commission is alive to the important factors affecting competition in world markets and no effort is being spared to ensure adequate supplies of electrical energy for the industrial, municipal, commercial and domestic needs of the citizens of the Province of Ontario. The annual increase in the Commission's load may be estimated at from 80,000 to 100,000 horsepower.

In the early half of 1926 the Hydro-Electric Power Commission, on behalf of the co-operating municipalities, entered into an important agreement with the Gatineau Power Company whereby the Commission eventually will receive 260,000 horsepower of Gatineau Power, 80,000 of which is to be delivered in 1928. In connection with this arrangement, the Commission has been subjected to some criticism, arising, it is believed, largely from misunderstanding respecting the general circumstances with which the Commission has to deal. Having to cope with an oncoming power shortage which was under attention by Sir Adam Beck, and recognizing the slow progress being made in connection with the development of power on the international section of the St. Lawrence River, the Com-

mission in 1923 began to negotiate for a power supply from the Ottawa River as the most favorable source from which satisfactory power could be obtained at the earliest date.

In 1925, when the Commission's load on the Niagara system aggregated some 650,000 horsepower, it was estimated that this load might, during 1926, rise to about 730,000 horsepower. It will be recognized that to provide for such a yearly increment in load, some definite arrangement had to be consummated. As a matter of fact, the Commission's estimate of increased load from 1925 has more than materialized. Only about 850,000 horsepower was available from the Commission's plants to meet the needs of the territory facing possible shortage. The Commission knew that Ottawa power could economically be transmitted over 200 miles, but such quantities of Ottawa power as the Commission could independently provide at an early date were not sufficient in amount to ensure economic transmission. The Commission had to obtain additional power, and after considering all the factors which governed—including that of having available a sufficient quantity of electricity for economic transmission—the Commission was gratified to find that arrangement could be made whereby the Gatineau Power Company could provide a sufficient quantity of power to make it economical for the Commission to construct a suitable high-tension transmission line.

Recent circumstances, including the probable further delay in connection with the proposed development of the St. Lawrence, have served further to demonstrate the soundness of the Commission's arrangements respecting the supply of electrical energy from the Gatineau River.

With respect to the proposals to develop the St. Lawrence River in the joint interests of navigation and power, it may be observed that although the recent report of the Joint Engineering Board has been tabled, yet it is difficult to foretell the time when power from Ontario's share of the international portion of the river can be made available. The Commission still looks forward to this St. Lawrence power as the principal source from which to meet the heavy future needs of Ontario municipalities. The Commission is continuing its own investigations on the St. Lawrence, and no factor that is germane to the consideration of this problem, so far as the Commission can deal with it, is being overlooked. The Commission hopes that debatable features incident to the problem will reach a satisfactory solution in the early future.

With regard to the financial status of the Commission and of the associated municipal electrical utilities, it must be remembered that the fiscal year of the local Hydro utilities closes on Dec. 31, and the compilation of the extensive statistics involved does not become available until later in the year.

In 1925, the total capital investment of the Hydro-Electric Power Commission in the undertaking under its immediate jurisdiction was approximately $199,000,000. In 1926, the corresponding total is $204,000,-

000, showing an increase of about \$5,000,000. The total investment of the municipalities in connection with their local Hydro utilities now aggregates about \$81,000,000 so that the total investment of the Commission and the municipalities in the whole undertaking is about \$285,-000,000.

The combined reserves and surpluses of the Commission and municipalities total about \$55,000,000. In this connection it is interesting to observe the substantial amount of these reserves compared with the total capital expenditure, and, further, to note the fact that the larger proportion of this amount has been accumulated during the last few years. This accumulation has been aided by the reserves set up in connection with the extensive investments for the purchase of the Toronto Power Company, the construction of the Queenston-Chippawa plant and the providing of new transmission lines with their inciden, equipment, in all involving a capital outlay during recent years of about \$110,000,000. From now on, the reserves and surpluses will accumulate at a strikingly rapid rate. In fact, this amount will approximate \$8,000,000 to \$10,000,000 per annum.

This is the provision in the Commission's programme through which the municipalities eventually will possess a hydro-electrical undertaking which has had its capital outlay completely refunded and this out of the relatively low rates paid by its consumers—rates which for similar service over such a territory are not paralleled elsewhere in the world.

Of the total population in the Province of less than 3,000,000, the Commission and the associated municipal utilities serve over 2,220,000, and have over 400,000 customers.

In the Commission's last annual report attention is drawn to the fact that the function of the Commission is not only to provide for the people of Ontario at cost an adequate and reliable supply of electrical energy, but also to ensure that the cost of that electrical energy to consumers shall be a minimum. That this object has been accomplished may be appreciated from the following very significant facts:

More than 80 per cent. of the electrical energy utilized for domestic service is sold in municipalities where the average charge to consumers of this class is less than two cents per kilowatt-hour.

More than 80 per cent. of the electrical energy utilized for commercial light service is sold to municipalities where the average charge to consumers of this class is less than three cents per kilowatt-hour.

More than 70 per cent. of the electrical power distributed by municipal systems and utilized for power service is sold in municipalities where the average charge to consumers is less than \$25 per horsepower per year.

In each of the above cases the consumers' cost quoted is inclusive of all charges.

The load on the various systems during the past month has at times aggregated approximately 1,000,000 horsepower. It is of interest here

to record some of the engineering and operating features even though individually they are not so spectacular as the Commission has been able to point to on some other occasions.

In the Niagara system, the ninth unit in the Queenston-Chippawa generating station was put into commercial operation during the year and this station is now up to a generating capacity that, in conjunction with the generating stations at the Falls, utilizes all the water at present available under treaty provisions.

In the Georgian Bay system the Hanna Chute development was completed. This is the second of a series of plants which the Commission plans ultimately to construct on the South Muskoka River, taking advantage of the various falls from the South Falls to the Baysville dam at the outlet to Lake of Bays. In connection with these plants on the South Muskoka River, the Commission has completed a storage dam at the outlet of Hollow Lake, which discharges into the Lake of Bays.

In the Thunder Bay system the advancement in the Commission's work is striking. At Cameron Falls generating station, on the Nipigon River, the fifth and sixth units have been put into operation, thus completing this development with an installed capacity of 75,000 horsepower. Sufficient stream flow for its satisfactory operation is ensured as a result of the construction of the Virgin Falls dam at the outlet of Lake Nipigon. During the year construction was commenced on the second Nipigon River development at Alexander Landing, where an installed capacity of 54,000 horsepower will be provided.

A feature worthy of special attention is the fact that in the operation of the Commission's systems there has been manifested remarkable continuity of service.

Up to the year 1926 the City of Fort William has been supplied with electrical energy under an agreement with the Kaministiquia Power Company. The agreement between the city and the company expired in December, 1926. Continuity in the supply of power for the City of Fort William, upon the expiration of its contract with the company, had, however, been provided for by a contract between the city and the Hydro-Electric Power Commission made in 1917 at the time a decision was being reached to develop power on the Nipigon River.

Owing to a shortage of power, due to low water at the plant of the Kaministiquia Power Company, Nipigon River power had already been supplied to certain industries in Fort William. This power, however, was sold by the Commission direct to the Kaministiquia Power Company. On Dec. 8, 1926, the change over from Kaministiquia River power to Nipigon River power was formally made, and in future Fort William, like Port Arthur, will be a "Hydro" municipality. The Kaministiquia Power Company will continue to supply power to its other power customers in the City of Fort William and vicinity.

During the past two or three years very substantial progress has been made in Ontario in the field of rural electrification. There is now more

than $4,750,000 invested in the rural power district systems established by the Commission. About 2,300 miles of transmission lines have been constructed to date, of which more than 700 miles were erected during the past year, this mileage exceeding that constructed in any former year. There are now nearly 19,000 customers supplied in the rural power districts.

With Gatineau power and such other power as the Commission anticipates will be provided in the near future from the Ottawa River powers, Ontario municipalities will be ensured against power shortage until 1932.

Preliminary work incident to the construction of the new 220,000-volt transmission line to convey Gatineau power is being advanced with all possible despatch. The appropriation of $14,000,000 for this line has been approved. Surveys are almost completed, and definite selection of the route is being made. The expenditure of such an amount upon labor and material in a public project must prove of advantage throughout the Province.

Although the more immediate future needs will be met from developments on the Gatineau and Ottawa rivers, the Commission looks forward to the time when it will have available further supplies of electrical energy from its own great developments on the international portion of the St. Lawrence River, where Ontario's share is about 1,000,000 additional horsepower. Eventually further power will be available from Niagara.

Ranking as it does with the greatest of the super-power systems of the world, the future prospects of the Hydro-Electric Power Commission are, it is believed, as hopeful as at any time in its history, and the Commissioners responsible for the administration of this great public undertaking are proud to be identified with an enterprise that is so representative of the initiative and resourcefulness of the citizens to whom it belongs.

How Hydro Has Succeeded

THE Hydro movement inaugurated many years back by the late Sir Adam Beck to provide cheap power for the many uses to which electricity can be put, depended for its success upon its ability to

1st—Spread the use of power into all corners of the Province,
2nd—Supply service at a low cost,
3rd—Continue to lower the cost as the use increases.

The measure of success thus far attained can be best illustrated by looking over the results of operation for the past ten or twelve years, and studying the statistics concerning the use of power in the various branches of electric service and the cost at which it is delivered.

In the Annual Report of the Hydro-Electric Power Commission each year are tabulated the kilowatt-hours consumed, the revenue derived from these kilowatt-hours, the number of customers served and various items of cost derived from these figures, but up to the present these figures have not been tabulated in such a way as to bring out what has actually been taking place in the Province as a whole, or in any particular group of municipalities, although the figures presented show what happens in each municipality, and the following tables derived from statement "D" in the Annual Report of 1925, are developed to show what progress has been made in achieving the aims of the Hydro movement.

Table No. I. shows the revenue, consumption and different items of cost for Domestic service from the years 1913 to 1925 in cities having over 10,000 population.

In tabulating the statistics in statement "D" it was necessary to omit the figures for certain municipalities because of the fact that when operation was commenced, in many cases statistics of a reliable character were not available for a year or two. For this reason the totals as indicated in Table No. I. and the following tables will not agree with the totals appearing in the other sections of the Annual Report. However, the percentage of omissions is so small as to not in any way affect the results obtained. Table No. II. shows similar information for towns over 2,000 population, and Table No. III. for villages under 2,000 population, and townships, while in Table No. IV. the totals for Tables Nos. I., II. and III. are shown.

A study of Table No. IV. shows to what extent the Hydro movement has spread since 1913, when it will be seen that the number of customers has increased from 49,200 to 326,307 in that period. The extent to which the cost of current has been reduced is revealed in the column, "Average cost per kw-hr." which shows a gradual reduction from 5.08c. to 1.80c. per kw-hr., and the extent to which the use of power has increased is shown by the last column. The consumption in 1914 of 21.0 kw-hr. has grown to 89.6 kw-hr. in 1925.

TABLE NO. I.

Data for Cities over 10,000 Population

Domestic Service

Year	No. of Munici-palities	Revenue	Kilowatt Hrs.	Consumers	Add for next year *	Av. Cost per Kw-hr.	Av. Monthly Bills	Av. Monthly Consump-tion Kw-hr.
1913				41,132				
1914	12	$ 614,925.00	12,646,400	55,597	1,802	4.86c.	$1.06	21.8
1915	15	700,799.00	18,314,400	71,816	4,521	3.83	.90	23.6
1916	17	774,391.00	25,477,700	89,138	4,200	3.08	.78	25.5
1917	19	1,063,264.00	36,693,100	107,248	4,656	2.89	.88	30.5
1918	21	1,257,589.00	46,116,700	119,956	....	2.72	.90	33.2
1919	21	1,511,821.00	59,200,200	136,243	....	2.55	.99	38.5
1920	21	1,926,924.00	84,328,000	154,186	....	2.29	1.11	48.4
1921	21	2,326,615.00	105,616,400	171,318	....	2.20	1.19	54.1
1922	21	2,795,746.00	140,176,900	188,993	....	1.98	1.30	64.8
1923	21	3,772,416.co	206,266,200	223,028	....	1.83	1.53	83.5
1924	21	4,249,144.00	245,884,000	233,769	....	1.73	1.55	89.9
1925	21	4,765,263.00	278,515,400	244,336	....	1.71	1.65	97.0

*Number of consumers of municipalities added to system during the current year, but no consumption available, although to secure proper average number of consumers during next year, these added consumers must be taken into account.

TABLE NO. II.

Data for Towns over 2,000 Population

Domestic Service

Year	No. of Munici-palities	Revenue	Kilowatt Hrs.	Consumers	Add for next Year *	Av. Cost per Kw-hr.	Av. Monthly Bills	Av. Monthly Consump-tion Kw-hr.
1913				6,238				
1914	19	$ 90,330.00	1,414,500	7,410	1,400	6.38c.	$1.11	17.4
1915	23	118,055.00	2,086,700	10,719	1,133	5.38	1.01	18.0
1916	24	150,338.00	2,924,100	13,467	634	5.14	.99	19.3
1917	27	180,075.00	3,824,600	15,731	1,223	4.71	1.01	21.4
1918	30	209,094.00	4,843,600	17,291	1,842	4.32	1.02	23.6
1919	33	262,832.00	6,548,600	20,848	1,654	4.00	1.09	27.4
1920	36	353,915.00	10,053,100	24,041	600	3.50	1.26	36.0
1921	37	450,600.00	13,386,900	28,483	1,780	3.34	1.42	42.0
1922	41	540,672.00	17,165,200	31,548	288	3.07	1.46	47.5
1923	43	651,499.00	25,411,300	34,135	....	2.56	1.57	60.1
1924	43	702,847.00	31,261,200	37,187	4,233	2.25	1.64	73.0
1925	48	888,507.00	42,305,200	42,854	....	2.10	1.75	80.5

*Number of consumers of municipalities added to system during the current year, but no consumption available, although to secure proper average number of consumers during next year, these added consumers must be taken into account.

TABLE NO. III.

Data for Villages under 2,000 Population

Domestic Service

Year	No. of Municipalities	Revenue	Kilowatt Hrs.	Consumers	Add for next year *	Av. Cost per kw-hr.	Av. Monthly Bills	Av. Monthly Consumption Kw-hr.
1913				1,830				
1914	18	$ 24,913.00	291,000	1,859	979	8.55c.	$1.10	13.1
1915	31	35,894.00	533,900	3,332	2,026	6.72	.99	14.7
1916	57	67,846.00	958,100	5,759	1,879	7.00	1.01	14.5
1917	77	97,516.00	1,412,500	8,334	748	6.90	.96	14.0
1918	88	116,994.00	1,780,400	9,638	1,037	6.59	1.04	15.8
1919	102	157,924.00	2,660,300	12,364	2,002	5.93	1.14	19.2
1920	109	233,819.00	3,829,900	15,665	1,314	6.00	1.29	21.2
1921	119	308,836.00	5,616,500	19,664	2,586	5.50	1.41	25.9
1922	135	424,754.00	8,379,900	25,036	1,027	5.06	1.49	29.5
1923	142	531,505.00	11,249,100	29,689	1,188	4.72	1.59	33.7
1924	152	596,844.00	15,463,200	32,831	4,408	3.86	1.59	39.9
1925	170	760,364.00	21,536,100	39,117	....	3.53	1.66	47.0

*Number of conumers of municipalities added to system during the current year, but no consumption available, although to secure proper average number of consumers during next year, these added consumers must be taken into account.

TABLE NO. IV.

DATA FOR ALL MUNICIPALITIES TOTALLED

DOMESTIC SERVICE

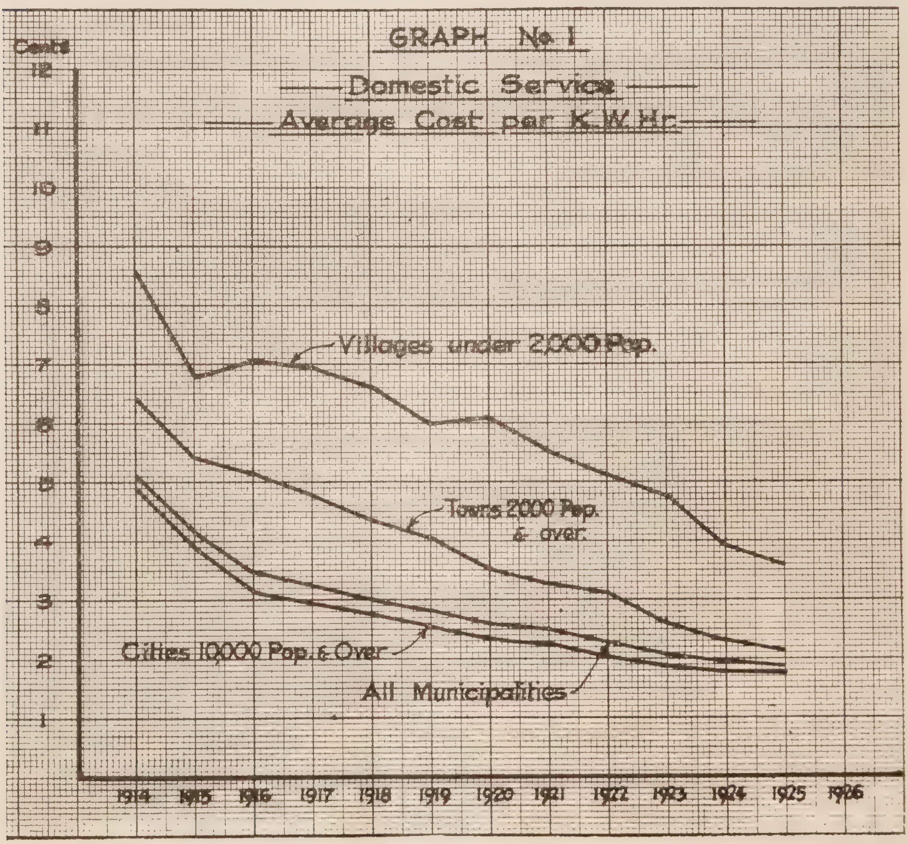
Year	No. of Munici-palities	Revenue	Kilowatt Hrs.	Consumers	Add for next year *	Av. Cost per Kw-hr.	Av. Monthly Bills	Av. Monthly Consump-tion Kw-hr.
1913				49,200				
1914	49	$ 730,168.00	14,359,100	64,866	4,181	5.08c.	$1.06	21.0
1915	69	854,748.00	20,935,000	85,865	7,680	4.08	.92	22.5
1916	98	992,628.00	29,359,900	108,364	6,713	3.42	.82	24.0
1917	123	1,340,855.00	41,930,200	131,313	6,627	3.20	.91	28.6
1918	139	1,583,677.00	52,731,700	146,885	2,879	3.00	.92	30.8
1919	156	1,933,577.00	68,409,100	169,455	3,661	2.82	1.01	35.2
1920	166	2,514,658.00	98,211,000	193,892	1,914	2.56	1.15	44.6
1921	177	3,086,051.00	124,619,800	219,465	4,366	2.48	1.24	50.0
1922	197	3,761,172.00	166,182,000	245,577	2,315	2.26	1.34	59.2
1923	206	4,955,420.00	242,926,600	286,852	1,188	2.04	1.54	75.7
1924	216	5,548,835.00	292,608,400	303,787	8,641	1.89	1.56	80.2
1925	239	6,414,134.00	342,356,700	326,307	....	1.85	1.67	89.6

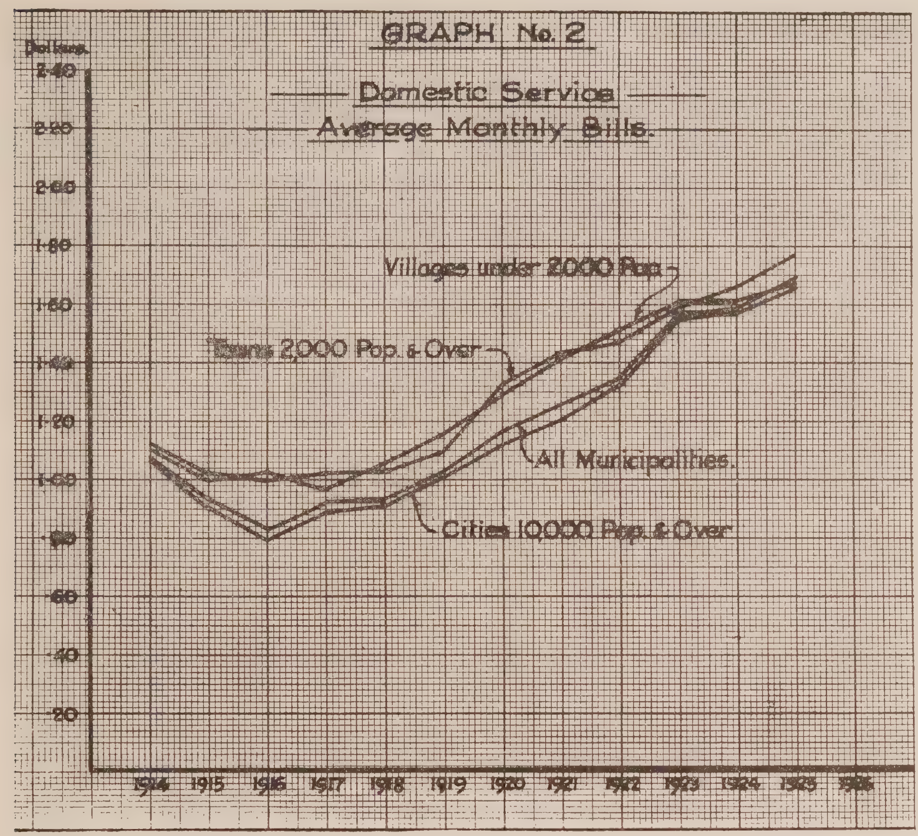
*Number of consumers of municipalities added to system during the current year, but no consumption available, although to secure proper average number of consumers during next year, these added consumers must be taken into account.

The average monthly bill is slowly creeping up, not because of increase in rates, but because of the increased use of power.

To show in a more interesting fashion just what has been taking place since reliable statistics were available, the following graphs have been prepared to illustrate year by year the trend of the progress of Hydro.

Graph No. 1 shows the gradual reduction in the average cost per kilowatt-hour in the three different groups, cities, towns and villages, and in all of the municipalities combined, and this graph is really the most interesting to study, and is, at the same time, positive proof that Hydro has succeeded in lowering the cost of power to all consumers, making it economical to use it freely. Graph No. 2 shows, under the same groups, the gradual increase in the average monthly bill, while Graph No. 3 shows in a very interesting way to what extent the use of Hydro power has been increasing year by year. A close study of this graph shows that in 1919, in all groups of municipalities, there was a sudden increase in the rate of use of Hydro power for domestic purposes. This is in all probability due to the waiving of restrictions in the use of power during the war period. A





smaller increase in the use of power was noted in 1922-23, and it may be safe to say that this increase is partly due to the inauguration, by the Hydro-Electric Power Commission of an advertising programme to spread among Hydro consumers information on the advantages to be obtained in the use of Hydro power in the home.

Graph No. 4 illustrates the extent to which Hydro power is used in typical municipalities, from the lowest to the highest, and it is remarkable to note that the average consumption in the Village of Baden is almost as great as that in the City of Toronto. There are many other small municipalities in the same position as Baden, and are reliable proof that cheap power has spread to the far corners of this Province, and is used abundantly.

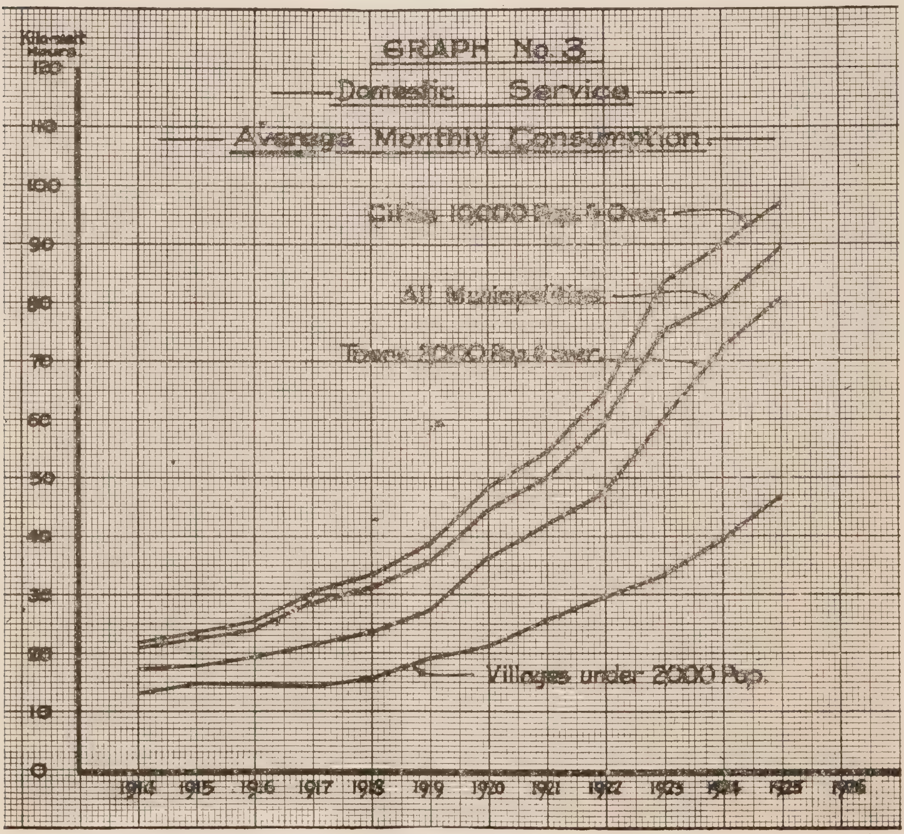
Tables Nos. V., VI. and VII. show in condensed form the statistics with relation to commercial lighting service in cities, towns and villages respectively, while Table No. VIII. summarizes these statistics and reveals some very interesting facts.

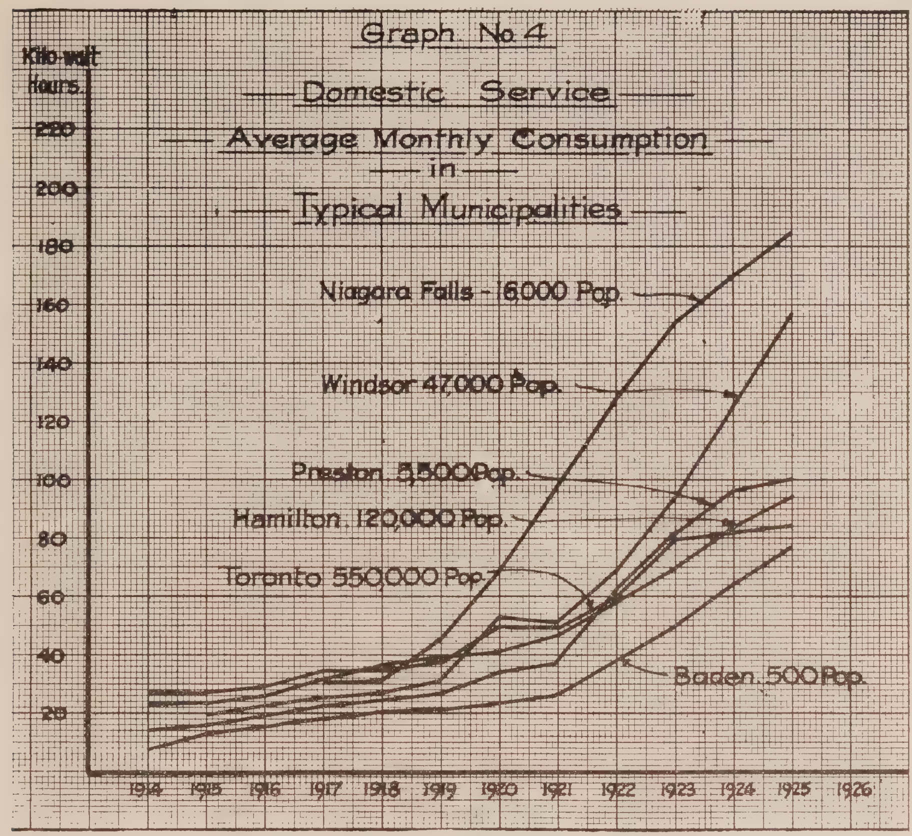
The number of consumers are shown to have grown from 13,113 to 56,018. The average cost per kilowatt-hour has been reduced from 4.00c. to 2.54c. and the use of power for this service has increased from

90.8 kw-hr. in 1914 to 235 kw-hr. in 1925.

There is a considerable difference between the average cost per kilowatt-hour for commercial service as expressed in this table at 2.05c., and the average cost per kilowatt-hour for domestice service in Table No. IV. at 1.85c. This is due to the fact that in designing the commercial rates at the inception of Hydro, there were many factors entered into the cost of serving commercial customers, which made that service more expensive to the municipality serving than did domestic service. Taking into account the fact that in the majority of municipalities commercial lighting service is not continuous night after night, considerable burden is placed upon municipalities purchasing power on a peak load basis, in the way of high demand with a corresponding low consumption, and the rates had to be designed to take care of this feature.

It would appear, however, that with the increased use of electric appliances in domestic service, with the increased use of lighting during longer hours of the day for both domestic and commercial service, and with the installation of motor driven appliances in both cases, domestic and commercial services





are more nearly approaching one another in character, and rates to take care of changed features in both services have recently been inaugurated, which will affect the results of operation from the present time on, not so much so in the case of domestic, where the increased use supported by the increased diversity is taking care of the increased cost to serve, but the commercial service will show somewhat of a reduction in the cost per kilowatt-hour and the average monthly bill.

To show here also in graphic form the progress made in commercial service toward reducing the price of power and increasing the use thereof, the following graphs are presented: Graph No. 5 showing the average cost of power gradually being reduced; Graph No. 6 showing the gradual increase in the average monthly bill; and Graph No. 7 the increase in the average monthly consumption.

The statistics in connection with commercial service are not quite so impressive as are those of domestic service, for several reasons, most important of which is that there are no general dimensions by which a commercial consumer can be measured.

In the small municipalities, stores and factories are small; in the larger

TABLE NO. V.

Data for Cities over 10,000 Population

Commercial Service

Year	No. of Munici-palities	Revenue	Kilowatt Hrs.	Consumers	Add for next year *	Av. Cost per Kw-hr.	Av. Monthly Bills	Av. Monthly Consump-tion Kw-hr.
1913				10,158				
1914	12	$ 536,350.00	14,048,500	12,439	437	3.80c.	$3.94	103.7
1915	15	526,119.00	18,684,400	14,512	1,037	2.86	3.26	113.9
1916	17	572,553.00	23,193,600	15,790	800	2.49	3.07	123.3
1917	19	642,989.00	27,479,800	19,573	1,103	2.34	2.96	126.6
1918	21	715,113.00	30,178,600	21,031	....	2.37	2.86	120.6
1919	21	861,342.00	40,049,200	23,282	....	2.15	3.24	150.6
1920	21	1,103,599.00	50,358,000	25,505	....	2.19	3.77	172.0
1921	21	1,376,751.00	58,607,100	27,510	....	2.35	4.33	184.0
1922	21	1,623,585.00	68,990,600	29,514	....	2.35	4.74	201.6
1923	21	2,043,197.00	91,146,500	32,016	....	2.25	5.56	246.9
1924	21	2,318,070.00	103,668,900	34,790	....	2.24	5.93	265.3
1925	21	3,124,526.00	131,445,500	39,074	....	2.38	7.05	296.6

*Number of consumers of municipalities added to system during the current year, but no consumption available, although to secure proper average number of consumers during next year, these added consumers must be taken into account.

TABLE NO. VI.

DATA FOR TOWNS OVER 2,000 POPULATION

COMMERCIAL SERVICE

Year	No. of Munici-palities	Revenue	Kilowatt Hrs.	Consumers	Add for next year *	Av. Cost per Kw-hr.	Av. Monthly Bills	Av. Monthly Consump-tion Kw-hr.
1913				2,165				
1914	17	$ 71,457.00	1,362,000	2,393	657	5.25c.	$2.61	49.8
1915	22	90,692.00	1,944,900	3,263	308	4.66	2.39	51.3
1916	24	119,826.00	2,732,700	3,674	350	4.39	2.75	62.8
1917	27	134,730.00	3,100,600	4,107	272	4.35	2.76	63.5
1918	30	142,602.00	3,336,900	4,410	472	4.27	2.70	63.3
1919	33	176,952.00	4,832,700	5,134	345	3.66	2.94	80.4
1920	36	221,867.00	6,179,400	5,736	58	3.59	3.30	91.8
1921	37	252,001.00	7,039,900	6,114	507	3.58	3.53	98.5
1922	41	288,571.00	8,226,700	6,779	126	3.51	3.59	102.3
1923	43	315,530.00	9,598,000	7,086	....	3.29	3.76	114.3
1924	43	319,162.00	11,173,600	7,437	684	2.86	3.66	128.2
1925	48	405,089.00	13,270,300	8,748	....	3.05	4.15	135.9

*Number of consumers of municipalities added to system during the current year, but no consumption available, although to secure proper average number of consumers during next year, these added consumers must be taken into account.

TABLE NO. VII.

Data for Villages under 2,000 Population

Commercial Service

Year	No. of Munici-palities	Revenue	Kilowatt Hrs.	Consumers	Add for next year *	Av. Cost per Kw-hr.	Av. Monthly Bills	Av. Monthly Consump-tion Kw-hr.
1913				790				
1914	14	$ 16,974.00	259,200	825	648	6.55c.	$1.74	26.6
1915	31	32,774.00	515,600	1,549	1,058	6.32	1.79	28.4
1916	57	57,405.00	939,700	2,752	862	5.89	1.78	29.2
1917	77	82,756.00	1,403,100	3,773	408	5.86	1.87	31.7
1918	88	90,054.00	1,538,000	4,129	461	5.45	1.80	30.7
1919	102	120,112.00	2,205,100	4,891	221	5.44	2.11	38.8
1920	109	152,497.00	2,799,500	5,255	222	5.89	2.45	45.0
1921	118	189,459.00	3,216,500	5,709	678	5.80	2.85	48.4
1922	135	231,825.00	3,998,700	6,805	249	5.37	2.97	50.9
1923	142	254,530.00	4,738,100	7,281	331	4.80	2.96	55.1
1924	151	270,195.00	5,632,300	7,910	660	4.79	2.90	60.5
1925	167	327,331.00	6,839,400	8,796	....	....	3.14	65.6

*Number of consumers of municipalities added to system during the current year, but no consumption available, although to secure proper average number of consumers during next year, these added consumers must be taken into account.

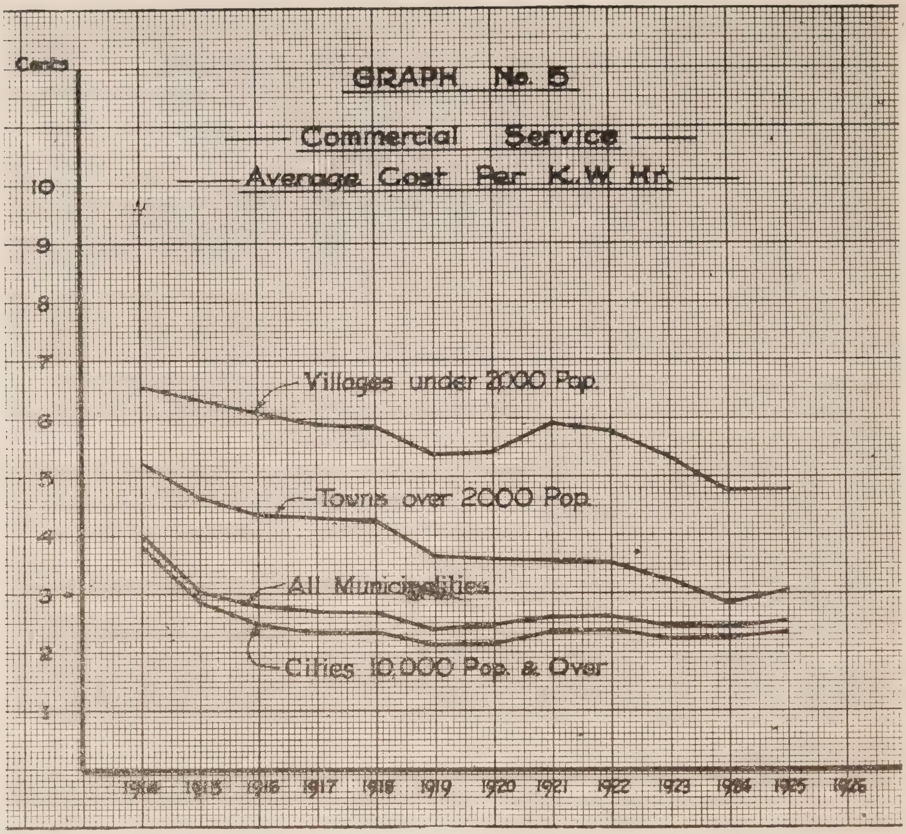
TABLE NO. VIII.

Data for All Municipalities Totalled

Commercial Service

Year	No. of Municipalities	Revenue	Kilowatt Hrs.	Consumers	Add for next year *	Av. Cost per Kw-hr.	Av. Monthly Bills	Av. Monthly Consumption Kw-hr.
1913				13,113				
1914	43	$ 624,781.00	15,669,700	15,657	1,742	4.00c.	$3.63	90.8
1915	68	649,585.00	21,444,900	19,324	2,403	3.03	2.95	97.3
1916	98	753,784.00	26,866,000	22,216	2,012	2.82	2.87	101.9
1917	123	860,475.00	31,983,500	27,453	1,783	2.69	2.77	103.1
1918	139	947,769.00	35,053,500	29,570	933	2.70	2.70	99.3
1919	156	1,158,406.00	47,087,000	33,307	566	2.46	3.03	123.0
1920	166	1,477,963.00	59,336,900	36,496	280	2.50	3.51	140.0
1921	176	1,818,211.00	68,863,500	39,333	1,185	2.64	3.98	150.8
1922	197	2,143,981.00	81,216,000	43,098	375	2.64	4.26	161.9
1923	206	2,613,257.00	105,482,600	46,383	331	2.46	4.80	195.6
1924	215	2,907,427.00	120,474,800	50,137	1,344	2.41	4.99	207.3
1925	235	3,856,946.00	151,555,200	56,018	....	2.54	5.98	235.0

*Number of consumers of municipalities added to system during the current year, but no consumption available, although to secure proper average number of consumers during next year, these added consumers must be taken into account.



municipalities they grow bigger, and in the cities they are bigger still. Furthermore, in the small municipalities and in some cases in the larger municipalities, the periods during which factories operate under artificial illumination, during which stores are open in the hours of darkness, vary so much that a real comparison between one customer and another, one group of customers and another, or the customers in one municipality and another cannot be made, but these graphs show that even in the smaller municipalities where conditions do not change very much, the storekeeper and others using power for commercial lighting purposes are gradually being educated to the advantages of plenty of illumination to display and sell their wares.

In the villages as a whole the average monthly consumption has increased from 25 kw-hr. to 65 kw-hr. per month; in the towns from 50 kw-hr. to over 135 kw-hr. per month; in the cities from 105 kw-hr. to almost 300 kw-hr. per month; and in all the municipalities combined from 90 to 235 kw-hr. per month.

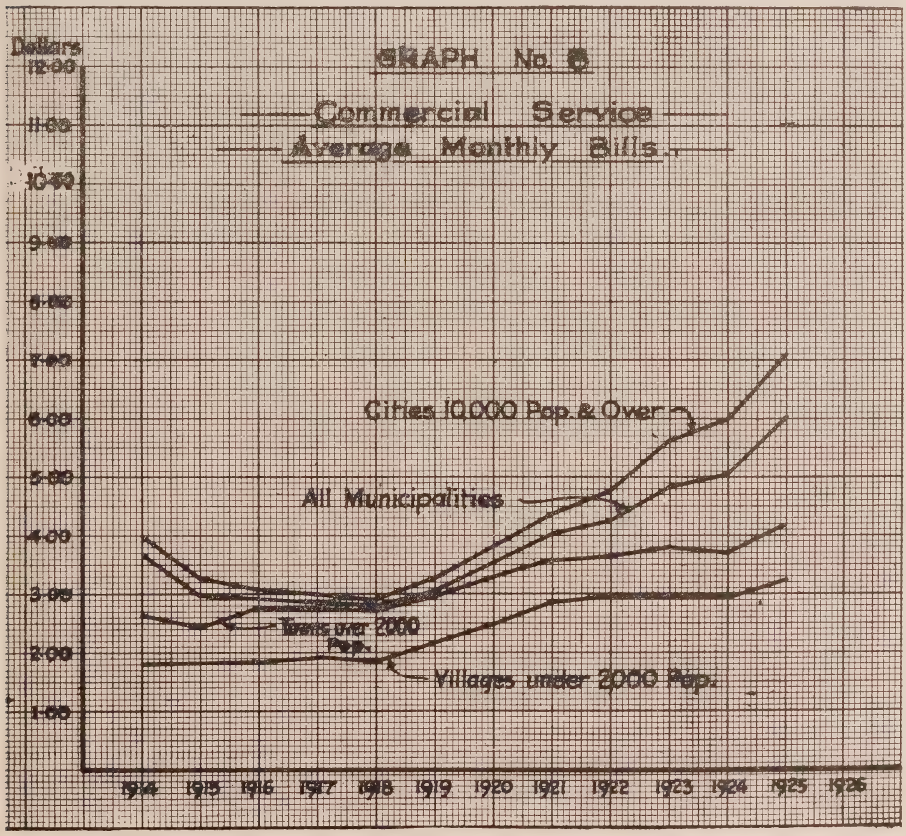
In Graph No. 7 we see illustrated again the effect of the waiving of restrictions put on during the war period, and both No. 3 and No. 7 Graphs answer one question which

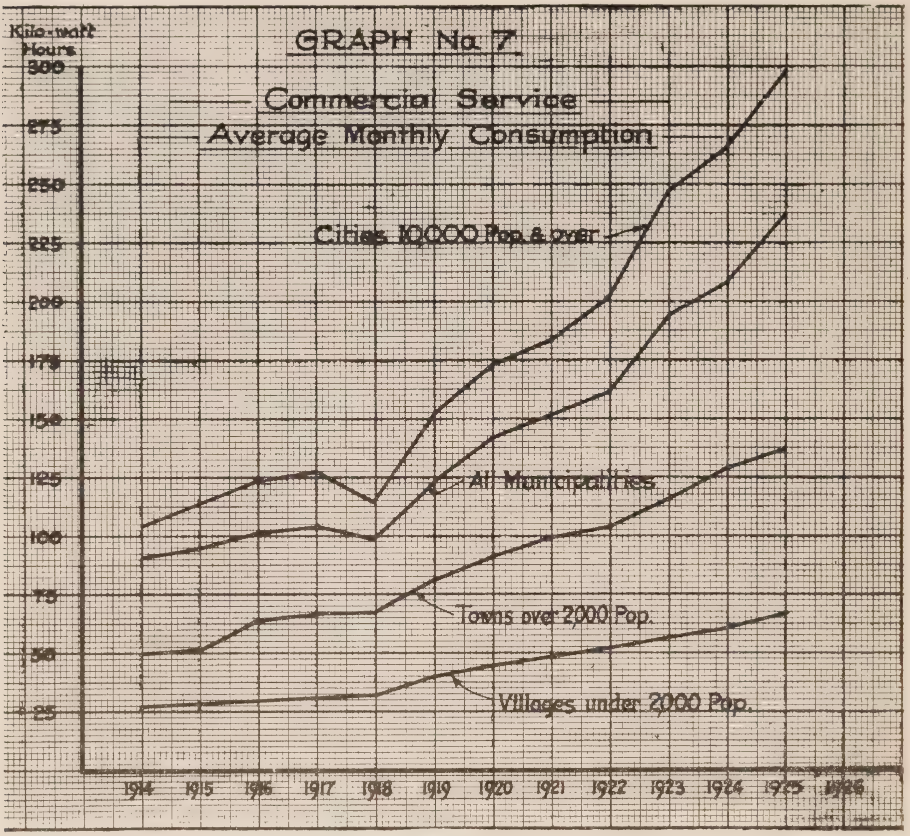
has arisen in the minds of a great many Hydro users since the war ended: What became of the power that was used for manufacturing munitions? Why was there not plenty of power to spare for years after 1918? These graphs show that many commercial and domestic consumers were starving for power, and the moment the war ceased they quickly absorbed the power which was released from the munitions factories. Many other conclusions could be drawn from these graphs, but space will not permit of more comment at the present time.

In Table IX. are shown for 1925 only, statistics in connection with power service, both commercial and municipal.

On account of the fact that kilowatt-hour consumption figures were not obtained prior to 1925, comparative figures for the earlier years of Hydro operation are not available, and even in 1925 the kilowatt-hour figures obtained in many cases did not distinguish between commercial and municipal service; that is to say, the consumptions for these two services were combined and were not separable for statistical purposes. However, wherever the figures were available, they were set apart and considered separately.

Table No. IX. gives some very





interesting information. The cost of power per kw-hr. for commercial purposes in cities is at an average of 1.20c., for municipal purposes at 1.05c.; in towns commercial power costs an average of 1.05c and municipal power an average of 1.10c.; and in villages commercial power is 2.38c. and municipal power 1.50c.; while in total the average cost of commercial power is 1.30c. and the average cost of municipal power 1.06c Under the heading "Municipal Power" are included water works, sewage disposal, municipal railways, and any other municipal services, separated from general commercial power by Hydro municipalities in their revenue classifications.

Now let us compare the cost of Municipal Power with the cost of Domestic Service, Commercial Service or Commercial Power Service, and we answer one of the biggest questions that has been in the minds of, we dare say, a lot of Hydro consumers, but chiefly those of private ownership enterprises. Is the cost of Municipal Service raised to enable Hydro Municipalities to sell power to Domestic consumers at a low rate and below cost? IT IS NOT. The cost of Municipal Power is lower by a large percentage than the cost to consumers of any of the other services. This is due very largely to the fact that municipal power is

TABLE IX.

POWER SERVICE 1925

		No. of Munici-palities	1925 Consumption kw-hr.	1925 Revenue	Av. Cost per kw-hr.
Cities over 10,000 pop.	Commercial.....	16	354,693,260	$4,262,540.00	1.20c.
	Municipal......	9	157,933,050	1,657,915.00	1.05c.
Towns over 2,000 pop.	Commercial.....	45	63,951,300	966,921.00	1.50c.
	Municipal......	10	1,637,300	19,130.00	1.17c.
Villages	Commercial.....	108	21,503,700	511,358.00	2.38c.
	Municipal......	8	460,800	6,851.00	1.50c.
Totals	Commercial.....	161	440,148,260	5,740,819.00	1.30c.
	Municipal.......	27	160,031,150	1,683,896.00	1.06c.

The number of Municipalities represented in the above statistics do not total up to the number of Municipalities served by the Hydro. The reason for the discrepancy is that quite a number of Municipalities did not report the consumption in kilowatt-hours for power consumers for 1925, 1 city representing a revenue of $529,468.00, 3 towns representing a revenue of $53,136.00 and 52 villages representing revenues of $90,114.00 being involved. This accounts for 217 of the 243 Municipalities served by the Commission; in the remaining Municipalities there are no Power Customers. The Municipal Power Consumption and Revenue in a large number of cases is included with that of Commercial Power, as the returns from the Municipalities did not separate them; in some other cases Municipal Power was not included at all as consumption was not available, 5 cities and a revenue of $82,764.00, 12 towns and a revenue of $38,567.00 and 24 villages and a revenue of $20,097.00 being involved. Neither of the above discrepancies would affect the general averages shown.

It is to be noted that the information given in this table does not include any of the power customers served directly by the Hydro-Electric Power Commission of Ontario, but only those receiving power from Municipal systems.

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controllable, and being so, it benefits accordingly.

Table No. X. shows in a similar way the cost of street lighting service per kilowatt-hour.

TABLE NO. X.

STREET LIGHTING SERVICE

1925

Wattage Installed	15,530,963
Hours Burning Assumed	4,100 per annum
Kilowatt-Hours	63,676,948
Revenue	$1,441,769.50
Average Cost per kw-hr.	2.26c.

By tabulating the installed capacities of all the street lights in use in the Province and assuming an average burning time of approximately 4,100 hours per annum, the consumption for street lighting purposes in Ontario was developed at 63,676,948 kw-hrs., and with a total revenue of $1,441,769.50 derived from street lighting in all the municipalities, an average cost per kilowatt-hour of 2.26c. was obtained. This may or may not be absolutely correct, but with a slight variation up or down of the number of burning hours assumed, or of the total wattage installed, the figures would not vary to a very great extent, and the cost of power for street lighting purposes may be safely taken at around 2.20c. per kw-hr. Here again it is shown that the cost of power for municipal lighting purposes is not higher than that for other lighting purposes, when we take into account the fact that special equipment both in the station and on the streets, is required for street lighting purposes, the slight increase per kilowatt-hour is justifiable.

If we deduct from the gross street lighting revenue the surpluses developed in the analyses of cost of street lighting in the various Municipalities on 1925 operation the net

TABLE NO. XI.

TOTAL OF ALL SERVICES

1925

	Kilowatt Hours	Revenue	Av. Cost per Kw-hr.
Domestic	342,356,700	$6,414,134.00	1.85c.
Commercial	151,555,200	3,856,946.00	2.54c.
Commercial Power	440,148,260	5,740,819.00	1.30c.
Municipal Power	160,031,150	1,683,896.00	1.06c.
Street Lighting	63,676,948	1,441,769.50	2.26c.
Totals	1,157,768,258	$19,137,564.50	1.65c.

amount of which is $82,142.00 the net cost per kw-hr. for street lighting purposes would work out at 2.14c.

It is to be noted that estimate of kilowatt-hours used for street lighting is for power delivered to the lamps and makes no allowance for losses in transformation or distribution.

In serving power and lighting customers, electricity is delivered at the consumers' premises at a voltage suitable for the operation of his equipment. In supplying street lighting, however, it is light that is supplied, and the costs include everything that is necessary for that purpose, including also lamp renewals and attendance.

Table No. XI. tabulates in total the consumption and revenue of all five services, and shows that Hydro power is distributed to all Hydro customers in the Province of Ontario, exclusive of rural customers, upon whom no reliable statistics are yet available for 1.65c. per kw-hr.

That Hydro power is a success need hardly be repeated. These figures and graphs speak for themselves, and the march of progress has only begun.

PENSION FUND

Notice to Contributing Employees

NOTICE is hereby given that an election to the Pension Board of members representing the contributing employees of the Commission, as provided for by Regulation VI., will be held during the month of March, 1927.

Nominations for the said representatives shall be made by any member of the Pension Board, and may be made by the Commission on behalf of any contributing employee or employees who have submitted names to the Commission for such purpose.

Names for nomination may be submitted to the Commission by contributing employees through the heads of their respective departments; such names to be in not later than February 22nd, 1927.

John Littlejohn,

Secretary, Pension Board.

Application of Hydro-Electric Power to Farm Work

Article No. 6.

ABOUT nine years ago, in making extensions from Woodbridge to serve Maple and intervening districts, service was connected to the farm of Mr. Thos. Keffer under a contract based on the conditions known to exist in the district at that time, and at a rate estimated to cover the cost which included a service charge almost double that which he is paying to-day.

Mr. Keffer, being progressive, made his installation quite complete even at the start, and there have not been many additions made to it since then.

Below is given the installation as it is to-day and, in addition to this, the net cost and power consumption for the year ending 1926.

Installation as at January 17, 1927

In the House—

29	40 watt lamps on 6 switches	
2	40 watt lamps on 1 switch for verandahs	
2	Bare Plugs	1,240 watts
	Electric Iron....	600 "
	Washing Machine	186 "
	2-burner Hot-plate.........	1,000 "
	Air Heater......	1,100 "

In the barn and other buildings—

21	40 watt lamps on 5 switches	
2	60 watt lamps in yard on 1 switch	960 "

Home of Mr. Thomas Keffer.

1	5 h.p. Motor....	3,730 watts
	Total.....	8,816 watts

Net cost and power consumption for year ending October 31, 1926—

Period Ending	Consumption in kw-hrs Total	at 2nd Rate	Net Bill
Dec. 31.....	737	597	$ 25.87
Mar. 31.....	969	759	36.34
June 30.....	485	275	27.63
Oct. 31.....	776	496	39 17
	2,967	2,127	$129.01

Rate—

Service Charge, $4.90 per month.
Power, 5c. per kw-hr. for first 70 kw-hr. in each month.
2c. per kw-hr. for the balance.
Discount, 10 per cent. on whole bill.

Liberal uses are made of the services on this place. In the house, besides lighting, the washing machine is used for 4 hours per week, the electric iron 4 hours per week; the air heater probably averages about an hour a day during the cold weather of the year, and the hot plate is used in the winter time for making toast only and in the summer time as a substitute for a 2-burner coal oil stove. In the barn the annual uses of power include besides lighting, the following:—

Chopping of 2,000 bushels of grain,
Rolling 800 bushels of grain,
Pulping 1,200 bushels of roots,
Milking 15 to 18 cows, twice per day all the year round,

Farm Kitchen showing some of the electric appliances used.

Running a cutting box for cutting straw or hay about 60 hours for the year,

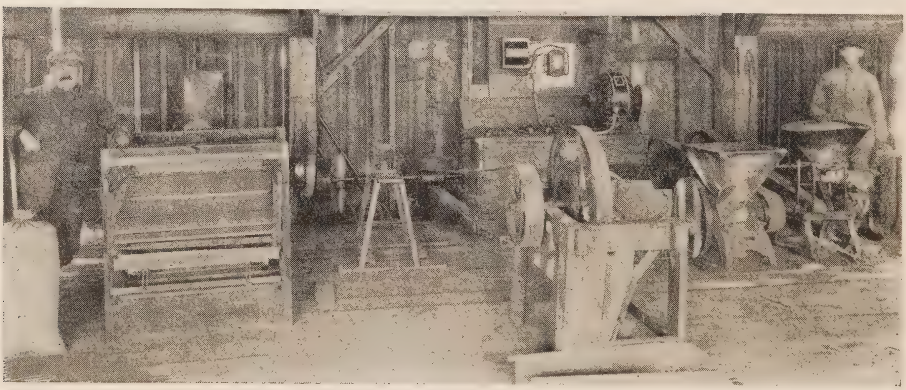
Operating a fanning mill for cleaning seed, grain and wheat for sale, 5 to 6 days per year,

Operating a meat chopper 1 day in the year.

In the cuts shown, each has its own title and indicates the neat form of set-up as far as convenience is concerned, but not ideal as far as some of the drives are concerned, the arrangement being an adaptation of electric drive to an installation which was formerly driven by gas engine, a line shafting in the mow not being ideal but an adaptation to meet the needs; another thing, the grain chopper should be driven direct instead of from the line shafting.

Grain Elevator in barn.

A novel feature not found on many farms is the elevator. While threshing, the grain is delivered from the thresher to the boot of the elevator, elevated to a point near the roof and flows by gravity through the spout to the desired bin, thereby making a convenient method of transporting the grain.



5 h.p. motor in barn belted to fanning mill, cutting box, grain tolls and chopper.

Sterilizing Eggs Electrically

A recent application of electric heating is for the sterilization of eggs. The sterilizing machines were manufactured by the Clairmont Sterilized Egg Corporation, San Francisco, and about ten machines have been installed on the Pacific Coast, some being in Petaluma and some in Hayward, California. Sterilization is accomplished by passing the eggs through an oil bath at 235 deg. F., the oil fills the pores in the eggshell and prevents air from entering. It is said that tests have been made which indicate that eggs so treated will keep odourless and fresh for years. A recent installation has a capacity of 350,000 eggs per 10-hour day, although it can be regulated to almost any speed up to that point. The sterilizing tank holds 45 gallons of oil, and is heat-insulated with a one-inch air space; the processing oil is circulated from a shallow pan near the floor to the sterilizing tank and back again by means of an automobile gear pump. The eggs are automatically dipped for 3-1/2 seconds, and heat control is maintained automatically. The machine is completely electric; the driving motor is rated at 1/2 horsepower, and the heat is supplied by eight 2-1/2-kilowatt oil-immersed heaters of the helicoil sheath-wire type. The total connected load is 20 kilowatts. Prior to the use of electric heat, steam, kerosene, natural and artificial gas, or gasoline were used as fuels. It was found that, although the fuel cost remained about the same as with gas, close heat regulation, a very essential factor, was obtained only with electricity. Further advantages of electric heat were found to be cleanliness and a saving in labour, two men only being needed with the electrical process, while a third was formerly used to regulate the heat. The electrical method was adopted only after all other forms of heat had been tried.—*Extracts from "The Electrical Review."*

Canada now leads the world in the public per capita distribution of electricity from central electric power stations. The figures of kilowatt-hours generated per capita per annum by the five leading countries are: Canada, 1,260, Switzerland, 886; United States, 581; Sweden, 467; Norway, 370.—*Natural Resources, Canada.*

The total horse-power installed in water-power plants in Canada has grown from 170,000 in 1900 to 4,290,000 at the end of 1925 and the horse-power per 1,000 of population from 45 to over 450, this increase per capita mainly representing increased manufacturing capacity. — *Natural Resources, Canada.*

In Ontario and Quebec, which contain about 82 per cent. of the manufacturing industry of the Dominion, about 90 per cent. of the total power demand, excluding steam railways, is met by water-power.—*Natural Resources, Canada.*

Distinguished Visitors

Early this month the Commission's offices were visited by an eminent author, globe-trotter and writer, Mr. St. Nihal Singh, who is well known in England, America and India. He was here to study the activities of the Commission, as he stated that we are looked upon as leaders of the world in hydraulics, distribution of power, service at cost, and supply of electric service to rural districts. During his stay he also visited the Commission's high-tension stations at Toronto, electrified farms near Toronto, and our plants at Niagara Falls. Mrs. Singh accompanied him; she is also a writer of note, whose work is mostly in connection with social, hygienic and living conditions in agricultural districts all over the world.

They were surprised to find such comfortable conditions in town and rural homes in Canada, especially in Ontario, Mr. Singh expressing himself as greatly surprised by the improvement in the twenty years that have elapsed since he was in Toronto.

On January 5, 1927, the Honourable Stanley Bruce, Premier of Australia, was the guest of the Hydro-Electric Power Commission of Ontario when a tour was made of the developments at Niagara Falls. Although Mr. Bruce had visited Canada on two former occasions, 1908 and 1919, he had never before seen Niagara Falls in winter. He was, therefore, first of all given an opportunity of viewing the Falls under ice conditions as they are then more interesting than during the summer.

Regarding the power developments, Premier Bruce showed a keen interest, both as to the physical work and also methods of control and financing. After having been shown through the Chippawa power house, he remarked, "During my brief stay in several of the cities of Ontario I saw and was told something of the extent of efficiency of the civic distribution of the Hydro and I have learned something of the plans of your Commission for further development. With what I have learned and with what I see today, I must confess my amazement." "The story of your cheap rates for domestic users is a veritable fairy tale. It sounds as if it is a story made up to impress gullible visitors."

Speaking of conditions in Australia, it was remarked that the water powers there were comparatively small, that they speak in terms of thousands of horsepower, while in Ontario, terms of hundreds of thousands or even millions are ordinarily spoken of. Referring to work being done in carrying power to farmers, he stated, "If I could do that for Australia our agricultural problems would be largely solved." His conversation as he inspected the plant showed that he was pretty well conversant with the whole history of Hydro development generally, but he was eager to add to his knowledge many details of the system which interested him greatly, and carefully noted a lot of data covering details which he carried

away with him, remarking: "I would have no fear for the future of Australia if we had a plant of this description."

Major, the Right Honourable J. C. Coates, Prime Minister of New Zealand, accompanied by Mrs. Coates, Mr. F. C. Thompson, Official Secretary, Mr. J. S. Hunter, Secretary of the State Railways of New Zealand and Mr. C. A. Berendsen, also of the State Railways, made a visit to Niagara Falls on January 16th, as the guests of the Hydro-Electric Power Commission of Ontario, Queen Victoria Niagara Falls Park Commission and the City of Niagara Falls, Ontario.

In addition to being shown the various points of general interest around the Falls, the party was conducted over the developments of the Commission, starting with the intake at Chippawa and ending with an inspection of the Queenston power house, after which a visit was made to Queenston Heights.

The Premier was visibly impressed by the power developments and displayed a keen interest in many of the engineering features. Referring to the Chippawa power house, Mr. Coates stated, "This is the most important I have ever seen. You have obtained the best that human mind can bring to bear on it. It is a wonderful plant and I am glad it is in the British Empire."

Referring to developments in New Zealand, the Premier stated that theirs were much smaller. They have five million horsepower surveyed and five hundred thousand horsepower under development. They have two developments under way at this time, one for one hundred and forty thousand horsepower and another of one hundred and ninety thousand horsepower.

The plan of financing in New Zealand is fundamentally the same as in Ontario. They define power board areas which comprise rural districts, boroughs and municipalities. These boards are elected and purchase their power in bulk from the Government.

Hydro News Items

Central Ontario District

Extensive changes are contemplated in the distribution system in the city of Oshawa. Some changes in the primary feeders have to be made and the size of the secondary copper is being materially increased to deal with the growing load.

* * *

The recent increase in load has necessitated the purchase of an additional 3000 k-va. transformer by the municipality of Peterboro. The street lighting in this municipality has been greatly improved recently by the substitution of incadescent lighting for the old magnetite arc. Suspension units have been adopted on many of the streets where the trees are numerous, and excellent results have been obtained by this means.

* * *

The change from magnetite arcs to incandescent lighting on the main street in Lindsay has just been completed. It is expected considerable economy in operation will result from this.

* * *

All consumers outside the Central Ontario System municipalities are now being placed in rural districts. These consumers were previously served at either city or suburban rates. In line with this, approval has just been received from the Commission for new rates for consumers outside the towns of Cobourg and Trenton.

* * *

Niagara District

A new office has been opened in Mitchell for the operation of the various rural power districts in that section of the province. The present districts which are in operation and will be serviced from this office are: Stratford, Mitchell, Listowel, Walton and Goderich. Mr. E. R. Martyn is the Rural Superintendent.

* * *

An agreement has been executed with a Company for a temporary supply of 400 horsepower to their works in Leaside and the work of constructing an outdoor station with 13,000 volt connecting line is now under way. It is expected power will be given on or about February 1st, 1927.

* * *

13,200 volt power was first turned on at the Beachville White Lime Co's 3-150 k-va., 13,200/550 volt substation on December 12th, 1926.

* * *

Hydro service was first supplied to the Police Village of Port Burwell on December 22nd, and to the Police Village of Kerwood on December 23rd, 1926.

* * *

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in December, 1926.

Appliances

Appliance Mfg. Company (Submittor), Hartford, Conn.

The Frank E. Wolcott Manufacturing Company, (Mfr.), Hartford, Conn.

"Curlex" Curling Irons, Cat. Nos. 15C, 21C, 22C, 23C, 80C, 81C and 82C.

* * *

Canadian General Electric Company, Limited, 224 Wallace Avenue, Toronto.

"Hotpoint" Portable Reflector Heater, Cat. No. A. 52.

* * * *

Day-Fan Electric Company, Dayton, Ohio.

"Day-Fan" Motors, repulsion induction type.

* * *

The A. C. Gilbert Company (Mfr.), New Haven, Conn.

The A. C. Gilbert Menzies Co. Ltd.(Submittor), 439 King St. West, Toronto.

"Polar Cub" Portable Fans; portable motor-operated Beater, B. 89.

Marking: Nameplate with rating.

* * *

Heat and Humidity Limited, 246 Confederation Life Bldg., Toronto.

Humidifier.

* * *

John S. McCormick, 13 Rivercourt Blvd., Toronto.

Circulation Type Water Heater.

Marking: Nameplate with manufacturer's name and the rating in volts and amperes.

* * *

Rotaprint Company, 52 Spadina Avenue, Toronto.

Rotaprint Machine.

* * *

Willard Storage Battery Company of Canada, Limited, 269 Campbell Avenue, Toronto.

"Willard" Radio "B" Power Unit.

Marking: Nameplate with manufacturer's name and primary and secondary ratings.

* * *

*Knox Porcelain Corporation, Knoxville, Tenn.

Lightning Arrester.

Marking: "Knox".

* * *

*Weber Dental Mfg. Co., The, Canton, Ohio.

Dental Equipment Stand.

Marking: "Weber Dental Unit" together with rating.

* * *

Switches

The Taylor Electric Mfg. Co. Limited, 526 Adelaide St., London, Ont.

Panelboards, "F. A. Safety". Types TP, TPD, NTP, NTPD, TC, TCD, NTC, NTCD, R, NR, R3G, NR3G, 2P, N2P.

*Betts & Betts Corporation, 645 West 43rd St., New York, N.Y.
Sign Flasher.

* * *

Fittings

W. H. Banfield & Sons, Limited, 370-386 Pape Avenue, Toronto.

Flush Device Boxes, flexible tubing pattern, Cat. Nos. 775, 776; with mounting strap and lath supporting clips, Cat. No. 785; rigid or flexible conduit pattern, Cat. Nos. 1003-06 incl.; armoured cable pattern, Cat. No. 1008.

Outlet Boxes, sheet steel, flexible tubing pattern, Cat. Nos. 1045, 1046, 1055, 26113, 26114, 36114; armoured cable pattern, Cat. Nos. 1008, 1085, 1086, 1095, 1047, 1048; rigid conduit pattern, Cat. Nos. 24151, 54521, 54531, 54541, 54551, 54561, 54571, 54581, 54591, 54151, 54155, 54171, 55151, 55171, 51151, 52151, 26125, 56111, 56112.

Covers for boxes; also steel covers for conduit fittings.

Marking: "B" in a circle stamped in the metal.

Box supports for outlet boxes and plates.

H. C. Bedlington & Co. Limited, (Submittor), 20 Wellington St. West, Toronto.

"Beco" and "Comco". Two-way Current Taps.

* * *

*American Electric Switch Co., The, Minerva, Ohio.

Enclosed Branch Circuit Cutouts. "Panelettes" Cat. Nos. 402, 404, 406, 408, 410 and 412.

*Propp Co., The, 524-28 Broadway, New York, N.Y.

Composition attachment plug, Cat. No. 55.

Separable attachment plugs, Cat. No. 526.

Marking: "Propp".

Current Taps, composition body, two and four outlet, Cat. Nos. 1, 2, 4, 11, 22, 44; three outlet, Cat. No. 30.

Marking: "Propp".

* * * *

*Roach-Appleton Mfg. Co., 3440 N. Kimball Ave., Chicago, Ill.

Outlet Boxes and Plates (As listed on Underwriters' Laboratories card dated November 12, 1926).

Marking: "Raco" or "A".

Box Supports. Types HB, HC, HD, HO, HS, SU1-6 incl.

Conduit Fittings.

Marking: "RACO".

Ground Clamps, for use with 3-in. rigid conduit or less, Type H; for use on signaling systems only, Type L.

Marking: Trade name, "Raco", size and type stamped on device.

* * *

Miscellaneous

Inventions Limited (Submittor) 1070 Bleury St., Montreal, Que.

"Rawlplugs" Hollow fibrous plugs for use as anchors.

* * *

J. Edward Ogden Co. Limited, 82 Richmond St. E., Toronto.

"Dryvins" Hollow Metal Expansion Shields for use as anchors.

* * *

*Trico Fuse Mfg. Co., 10th and Cold Spring Sts., Milwaukee, Wis.

Edison plug fuses.

Marking: Name of manufacturer and trade name "Clear-Top" with voltage rating molded in porcelain and ampere rating stamped in fusible link and center contact.

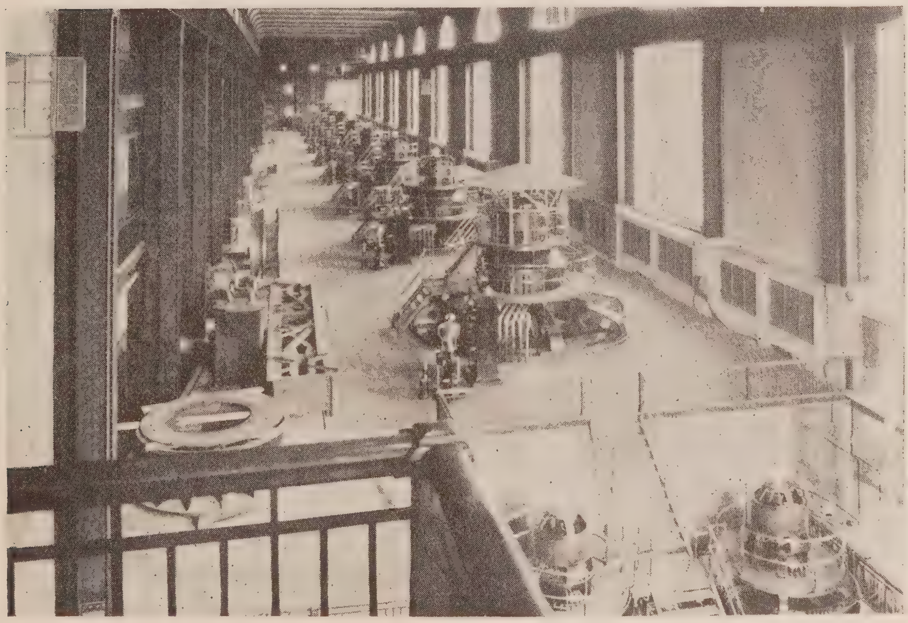
* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

The total horse-power installed in Canada for all uses except steam railways at the end of 1925 is estimated thus:—

	Horse Power	% of Total
Water-power...	4,282,000	80
Fuel power.....	1,068,000	20
	5,350,000	100

This is equivalent to fifty-seven one-hundredths of a horse-power per capita, a figure which is only slightly exceeded by that for the United States.—*Natural Resources, Canada.*



Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

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Glanford Township Booms Hydro Rural Service

A FITTING celebration marked the inauguration of rural power in the Township of Glanford on the evening of Tuesday, February 8th. A parade of about 60 motor cars started from Ryckman's Corners on the Hamilton-Jarvis Highway at 8.00 p.m. and proceeded to the point where the new line, the first in Glanford Township, commenced. A signal sky rocket was fired and the switches closed, accompanied by a burst of flares and fireworks. An answering rocket was sent up from Mount Hope, announcing the arrival of Hydro in the Village. The parade of cars then continued to the Glanford Community Hall in Mount Hope, where an audience of approximately 500 gathered to enjoy a most entertaining programme.

Mr. Austin Smuck, Reeve of Glanford, as Chairman of the meeting, opened the programme with a brief address. To the strains of the Dead March in Saul the gas lights were slowly lowered and with a burst of illumination Hydro was switched on amid cheering and applause. A short prayer, offered by Rev. Mr. McLachlan, was followed by the audience standing and singing the Doxology.

That Glanford Township is rich in local talent was demonstrated by the programme which followed. Musical and reading numbers were contributed by Miss Margaret Hines, Miss Jean Smith, Miss Edna Jerome, Miss Kavanagh and Mr. Walter Smuck. Mrs. Grant Jerome, the accompanist, officiated ably at the piano and was largely responsible for the success of the musical part of the programme.

Appropriate addresses were given by Ex-Reeve Leeming, Warden Pick-

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February, 1927

ard of Wentworth and Mr. Webster of McLary's, Limited.

The Ontario Commission was represented by Messrs. H. D. Rothwell, G. C. Parker and W. C. Rogers, Rural Superintendent, under whose direction the line was constructed.

One of the most interesting features of the programme was a lucky number contest, the prize being a Hydro Iron, donated by Mr. Rogers.

Mr. W. G. Merritt, Agricultural Representative, showed two motion picture films, one of which greatly pleased the younger members of the audience.

Following the programme a sumptuous supper was served by the local ladies.

The remainder of the evening was devoted to dancing. Music was rendered by the Caledonia Little Symphony Orchestra under the personal direction of Mr. Cecil Shaw. Dancing was continued until well after midnight.

The entire event was unique. Seldom has a rural district shown such enthusiasm nor given evidence of such a strong community spirit. Judging from the reception accorded the turning on of power it will be a matter of but a very short time before the entire Township is served by rural lines.

Grounding on 4,000 Volt Distribution Circuits

By W. B. Buchanan, Assistant Laboratory Engineer, H. E. P. C. of Ontario

(Read before Association of Municipal Electrical Utilities at Toronto, January 20, 1927).

SOME time ago the laboratories were requested to take part in a study of conditions which existed on a rural distribution circuit and services fed therefrom and the results obtained were of such striking character that it was felt they would serve as a basis for discussion of the general problem of grounding of distribution circuits.

The system was of the type which had become fairly standard, viz., a three-phase four-wire distribution circuit at 2300-4000 volts with the neutral wire grounded at all service transformers, the 220-110 volt secondary circuit having its neutral common with that of the high tension. The arrangement of connections was as indicated in Fig. 1. At the time these readings were taken a tree had fallen across the high tension feeders and the high tension neutral was open at a point between the substation and the locality where the tests were made. The result, of course, was that the ground connections at the load end of this break would have to carry the unbalanced part of the currents in the three phases without the assistance of the overhead ground wire except in so far as it served to connect them in parallel.

Two services particularly were drawn to our attention. At the first

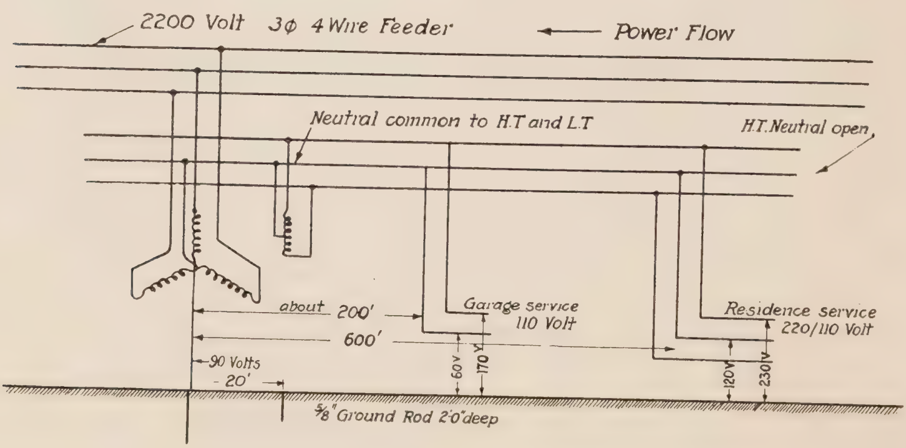


FIG. 1

a gasoline station service with two wire supply about two hundred feet from the service transformer, operators were getting electric shocks when operating the handle of the gasoline pumps, also from the handle of a hard water pump located in the yard.

At the second, a residence service about six hundred feet from the service transformer, reports indicated that the voltage drop was excessive, the unbalance of voltage on the two sides of the circuit was so great that in order to obtain satisfactory illumination from one side of the circuit, it was necessary to load the other side by means of range elements, shocks were obtained from parts that should normally have been at ground potential and occasionally lights would appear in fixtures without any operation of the switch installed for its control.

Readings were taken in the early afternoon at the service station from the two wires of the 110 volt circuit to water piping at that point and voltages of 60 and 170 volts were obtained. Under similar conditions but not simultaneously therewith the voltages at the residence were zero, 115 and 215 volts. The unbalanced nature of these voltages indicated that the so-called neutral wire might rise to quite high voltages above that of the surrounding ground potential, and that with greater unbalance of load currents the service wires might rise to potentials hazardous to the occupants. Two additional ground rods were driven and tied to the neutral overhead at adjacent poles. A test ground rod was then driven in the bottom of the ditch about 20 feet from the original ground rod and a reading of 90 volts was obtained between this and the test ground. The value of the current flowing to ground at the time was not known but as it was before the period of the evening lighting load the current was assumed to be less than would occur under full load conditions.

The component parts of this problem might be discussed briefly as follows:

A. *High tension neutral resistance.* Calculations will show that if the unbalance of load between the three phases be as much as fifty per cent. of the rated load on one phase and the combined resistance of ground and fourth wire be twice that of a phase wire there would be a neutral drop in the more heavily loaded phase as great as would occur in the line wire. Hence it would appear that where there is considerable diversity in the loads taken by consumers in a locality, the conductivity of the neutral should be approximately the same as that of the line conductor.

B. *Ground rods and their grounding resistance.* Properly installed they shunt part of the neutral current but their resistance at best is usually high (20 ohms and up), hence they are not of much benefit in paralleling the fourth wire for short sections, e.g., one-half mile or less and the neutral wire must carry the larger share of the unbalanced current. It thus appears necessary to provide ample current-carrying capacity in the fourth wire because it is more reliable and probably less expensive than to plant a very low resistance

ground at every service transformer. This question would have to be decided for each special case.

C. *Separation of high and low tension neutrals.* A study of the circuit diagram will show that with common neutral for high and low tensions there is a possibility of fairly high voltages entering the consumer's premises. Keeping in mind that the test voltage on heaters, irons, etc. for 110 volts when hot is only 500 volts and that of sockets is 600 volts, the need is apparent for keeping extraneous voltages off the low tension entirely. Fixtures must not be used on circuits having a potential of over 150 volts to ground (H.E.P.C. Rules C.7a, 1924). This feature becomes one of life hazard and not simply one of operating inconvenience.

D. *Grounding of the low tension neutrals.* If there were no chance whatever of extraneous voltages appearing on the low tension wiring, no doubt the less hazardous plan from the consumer's standpoint would be not to ground the secondary at all; but the hazards of cross-overs with higher voltage lines and the possibility of faults in transformers are too great to leave a 110 volt system ungrounded. H.E.P.C. rule Section E11 (h) requires "Grounding connections to alternating current distribution systems must be made to points of the systems (consistent with reasonable cost and practicability) which will result in the voltage between ground and the secondary conductors being a minimum." It is thus permissible to ground the secondary elsewhere than at the transformer and if high voltages be set up at that location due to high tension currents, then by the present rules it is necessary to locate the low tension ground elsewhere.

Rule E11 (c) rates a satisfactory ground resistance as less than 25 ohms and E11 (b) requires that a ground have an area of 2 square feet and this should be below the permanent moisture level. It will be evident that these rules give some recognition of the hazards that may be introduced through high neutral ground resistance.

E. *Method of measuring resistance of isolated grounds.* In view of the importance of knowing the resistance of the grounds which are used at service transformers and arresters a convenient method was devised for measuring isolated ground resistances in cooperation with the Distribution Section. The method consists of passing current up to 10 amperes into the ground and measuring the voltage drop between the ground wire and some convenient point not less than 25 feet distant. Fig. 2 indicates the essential parts of the circuit and apparatus during a test.

The service transformer is not usually loaded heavily enough to supply as much current as is desirable and it was found necessary to supply additional current and this was done readily by means of a 2200 volt resistor taking eight amperes. It was also found necessary to disconnect the ground wire from the overhead neutral as the overhead wire and connected ground provided a shunt of low resistance across the ground being measured. The transformer connection to ground is not

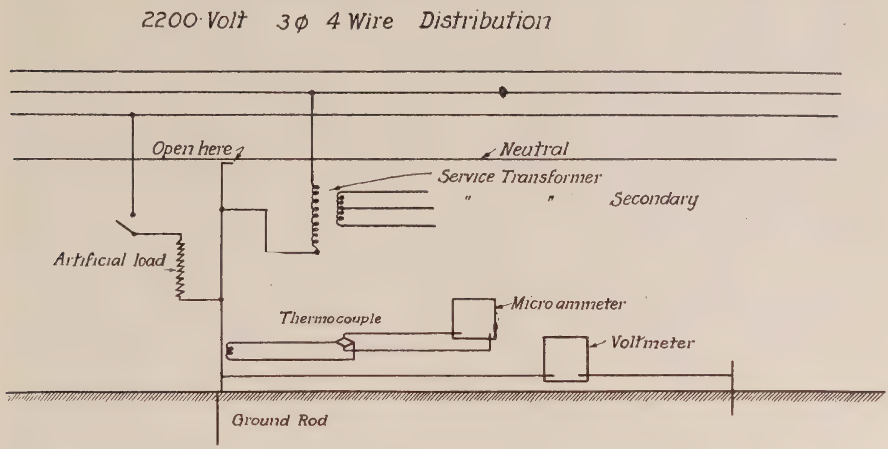


FIG. 2

opened and the service not interfered with. The transformer connections to ground and to neutral *must not be opened at the same time* unless the cutouts have been opened.

Current is measured by use of a clamp-on current transformer on the wire at the foot of the pole, the secondary leads from this to a thermocouple and thence to a microammeter. This set was calibrated at 25 cycles before leaving the laboratory and worked satisfactorily.

Voltage is measured from the ground wire at the foot of the pole to any convenient location not less than 25 feet away. Such things have been used for external voltmeter terminal as an iron pump in a well 100 feet away, a guy-wire anchor on the opposite side of the roadway, a wire fence across the roadway having driven steel posts, etc. A plate of sheet iron in a water hole in the ditch could be used or failing any of these a pipe or rod terminal would have to be driven.

The justification of using such a simple method lies in the fact that the resistance of the ground when contact is made through a small rod or plate has approximately 90 per cent. of its value within about 25 feet of the ground wire. Hence a voltmeter having one terminal on an equipotential surface anywhere outside this range should give as result a resistance which is within 10 per cent. error.

Typical readings are as follows:

Location	*Current*	*Voltage*	*Res. (calc.)*	*Type of Terminal*
1	7.1 amp.	176	25 ohms	Iron pump in well
2	5.8 "	400	69 "	Guy wire at 50 ft.
3	6.9 "	290	42 "	" " " " "
4	7.0 "	112	16 "	" " " " "

The method, in addition to being simple, is speedy. From fifteen to twenty isolated grounds, e.g., one half mile apart, can be measured in one day by one gang.

A large number of grounds were tested by our Distribution Section between October 28 and November 11, 1926, and the results classified roughly as follows: Five-eighths and one inch ground rods, six feet long in clay and sand.

Resistance over 100 ohms each	3 in sand	
50-100 " "	4 in sand,	2 in clay
25-50 " "	6 " "	6 " "
10-25 " "	5 " "	44 " "
5.5 " "	0 " "	1 " "

As only seventeen of these rods were of five-eighths inch diameter no accurate comparison can be drawn between the advantage of a one-inch rod over the former. Any comparison that may be made is in favor of the one-inch rod but is not sufficiently marked when the other variables are taken into account, e.g., the contact pressure between soil and rod, the variation in the moisture in the soil, the length of time the various rods had been installed, etc.

The question immediately arises as to the best method of improving these ground resistances. In some cases parallel ground rods or plates well distributed would be the only solution, in other cases a service might be located on the top of a dry hill and a more efficient ground could be planted a few spans away in a river bed or moist soil.

Discussion

Mr. Buchanan: Two or three points have been mentioned in connection with this and I think it is important to get a perspective on some of these points, but we can only get that by looking at the quantitative results. One question is, "What happens when the ground is frozen down a certain distance?" Well, we know that snow and ice is practically an insulator, so that, if you depend on the conductivity from the surface down and you get three feet of that frozen, your conductivity is going to be reduced to that extent. Snow and ice are practically perfect insulators. With respect to the conductivity of water itself, as a life hazard, we consider water as a conductor, but insofar as engineering qualifications are concerned, it is hardly entitled to that status. I mentioned a figure the other day to one of the engineers, that the resistance of water is practically one hundred million times that of the same volume of copper. Think of the proportions. The specific resistance of water is 100,000,000 times what copper is, and looking over some test figures we have, I find that this ratio was very much below the ratio we had obtained on those tests. It actually

figured at fifty thousand million times. So, you see, as far as its engineering merits as a conductor are concerned, it is negligible, and on that account, when we plan grounds for power systems, we have to go to very large areas to get our ground resistance down to any reasonable value. Those who are interested in metering might like to note that with the scheme suggested, we can read down to two amperes in the ground wire and above four amperes the reading is fairly accurate. The corresponding deflection using any alternating current ammeter available was not reached at less than fifteen amperes. Hence this method has six or eight times the sensitivity of the ordinary alternating current method, but the thermocouple and the microammeter are special instruments. Now, as I suggested, the first primary purpose of this paper is to open up discussion on the question. I understand there is a Committee considering the proposition of a 2200 volt service and groundings and associated problems, and, of course, these details will all have to be threshed out. But insofar as we are concerned in the laboratory, we are glad to obtain any data that it is possible to obtain on these questions. The engineers are very much at sea unless they are able to get reliable data to work with, and if we can render any assistance in obtaining the data, or in devising ways and means, not necessarily standard ways, because we are able to invent to some extent as well, then we get the data as accurately as it is possible to obtain.

Mr. J. S. F. Madden, H.E.P.C. of Ont.: I have listened with very unusual interest to Mr. Buchanan's paper, because he referred to a system that I was interested in. I want to say this, that the life hazard is a thing that bothers me very seriously, and when I uncovered this particular case, I found that the customer had made a complaint.

As for the solution of this problem, the best way that you can help to solve it is to discuss it freely; and if you have any cases of the kind on your own systems, don't keep them covered up. The engineers at the laboratory are hunting for experience in the field that they can put to good use in standardizing a practice that would eliminate a lot of the hazard.

Mr. F. T. Stocking, H.E.P.C. of Ont.: The question of area of the ground material is too strongly emphasized. Very often, the part area plays is of relatively small importance so long as you have a reasonably tight contact with the soil and a reasonable area. After the current is gotten away from your grounding material, it has to go through the ground, and a great proportion of the resistance is through the ground in the vicinity of the grounding rod or grounding material. If your ground rod or grounding material is very loosely connected with the soil, the ground will not be particularly good. But if it is well connected with the soil in just a few points, the area of the ground rod is not of so much importance. That matter was gone into very thoroughly by a number of Companies about twenty years ago,

and it is too bad that some of that literature cannot be assembled and put into a paper, because it was very important, and there were some very good papers written on it.

Within a few feet of your single ground, your results are about the same. That is, it doesn't depend altogether on the area of the ground, but it requires a multiplicity of grounds to give good results. It is impossible to make a single effective ground commercially feasible, as it would have to be spread over an area of many feet to secure good results. It was discovered, by experiment, that, by having a multiplicity of relatively small pipe grounds properly spaced, the results would be very much better. The question of area of ground is therefore too much stressed; the number of grounds and their depth being of greater importance.

Mr. J. W. Purcell, H.E.P.C. of Ont.: A number of years ago, the question of grounding was brought up in connection with the Underwriters' rules, and there was an enormous amount of investigation and a lot of information assembled, which I think should be available to us. I think we should assemble all this information with their data and make it available through our records. In rural work we use a method of grounding that is a little out of the ordinary. There is usually a manure heap on every farm, and ammonia happens to have a high value for grounding. I believe it improves the conductivity of the earth and in that way improves conditions. There seems to be a practice in places of connecting more than one service to the same ground. I believe that is an improvement and that that point should be stressed in connection with the consideration of the using of grounds.

The Chairman: In speaking to Mr. Wills Maclachlan last night, he stated they were working on the subject of grounds, and expected to have a report in about three or four months' time. Regarding the matter of separating the grounds, I think it is the consensus of opinion—at least of the American Bureau of Standards — that lighting arrester grounds should be altogether separate from the distribution grounds. I think that is very strongly stressed in their Bulletin No. 108.

Mr. E. V. Buchanan, London: I would like to ask Mr. Buchanan what he thinks of the effectiveness of using a water pipe system in a city for a ground.

Mr. R. H. Stafford, North Bay: We have a system at North Bay which is grounded throughout to the water pipes, because we have nothing else to ground on, a large area of the town being on solid granite rock. We ground arresters, transformers and everything else in this way. We have no records that I know of for the past ten, twelve or fourteen years, of casualties of any kind. In our experience, it has worked very well.

Mr. W. R. Catton, Brantford: We use a 4,000 volt system with grounded neutral in Brantford. We carry a neutral right along our primary, which is bonded to the secondary neutral. The secondary neutral is carried through from one

district to another, and is also bonded to the water pipes through the services. But even though we are fairly well grounded, I have noticed that, when anything does happen to a feeder, especially a power feeder and open the circuit, the Bell Telephone Company soon call us to tell us that all the party line telephones in that district are ringing, and they continue to ring until we find the trouble.

Mr. E. V. Buchanan: I would like to know how far your grounds are apart?

Mr. Catton: As I say, the primary neutral is tied into the secondary neutral, which, in turn, is tied in most of the services to the water pipe in the houses, which are fairly close together. With all these grounds, there seems to be current flowing in the primary, which is in trouble.

Mr. J. E. B. Phelps, Sarnia: In Sarnia, on the Beach system we had trouble with our grounds during summer. With all due respects to Mr. Buchanan's ideas of water and the resistance of it, we found out that, during the spring months, we hadn't any trouble at all with our grounds. As the weather got hotter, and July and August came along, we had trouble with our grounds, which were in a very sandy soil. To get what we thought would be a better ground, I gave instructions to hook up our neutral to the street railway return rail. Next day we put a volt meter on, and got a reading of eighty volts. Previous to that, we had got a reading of about twenty-five volts to ground. We found that when we began our reading, a street car had started on a trip. As this car came along, we finally got our voltage back to twenty-five volts again. We informed the Street Railway Superintendent who went out and discovered that about a mile from this point where we were measuring, one of his rail bonds was broken. I was interested in the part of the paper which said a multiplicity of grounds is necessary. We put in more grounds and got better results. We made up one of galvanized sheet metal with nine square feet of an area. I always thought a large area of ground was an improvement; but, according to Mr. Stocking, that is a non-essential. It is the tightness of the rod in the ground that counts.

Mr. C. E. Kirkby, Brantford Twp.: I had an incident in connection with the Brant Rural district which came to my attention a year ago last summer, which might possibly prove of some interest. The primary neutral of a feeder had been down for about two weeks, without our knowing it and without any interference with the service. The line running into the district was a two phase primary with one ground wire, and this ground wire is grounded in accordance with the rules of the H.E.P.C. with an ordinary driven ground. A farmer had noticed it for some time, and wondering why we had not fixed it, finally phoned in and advised that the wire was down. There was no evidence of any current flowing in it.

Mr. S. B. Iler, H.E.P.C. of Ont.: While I was with the Brantford system, we grounded the secondary

by a very extensive grounding system of pipe grounds and ground mats laid irrespective of what the soil conditions might be. I then made what I thought was a careful inspection to see that the grounds were all on the neutral, and none of them were on the outer of the secondary. He must have been in a hurry. I left Brantford about 1913, and I understand some time in 1914, Mr. Catton has since discovered at least two cases where the outer was connected to a ground driven in sandy soil. I mention this to indicate what little value a poorly placed pipe ground may be.

Mr. Catton: Mr. Iler is right. We found some instances where the outers were tied to these grounds.

Mr. W. B. Buchanan: In respect to Mr. Stocking's comments on data obtained some twenty years or so ago, I might suggest that we have learned a great deal in the last twenty years, and having had a great deal of experience collecting and trying to digest data coming from different sources. Not knowing where, when, nor under what circumstances it was derived, leads one to be very suspicious. We put up against that our own experiences, not simply one case but a great many cases, and having due regard for the circumstances surrounding it in general, we expect better ground resistance with larger areas. We might tell you of one case where we put in a neutral ground resistance for a power system of some ten or fifteen thousand kilowatt capacity, and we took a sheet metal siding three feet by eight feet, and used four plates, thrown into the bed of a river to get down as low as twelve ohms. We wanted some resistance and that seemed to give us a satisfactory operating value.

The other point brought up. Someone seems to think that water is not so high as that in resistance, but remember that organic matter, acids, even in small quantities, reduces the resistance quite a lot, as Mr. Purcell mentioned. There are locations where you get very good grounds without very much trouble, without very large areas, but as a rule, our river water is what we are discussing now, and this applies most particularly to rural districts. We have not the facilities of water systems to use as grounds, and it is difficult to get a lower resistance between the conductor that goes down to earth and the potential of the ground at a distance therefrom.

In respect to Mr. Buchanan's question, I think it is good practice, and I know the cities are most fortunate to be able to get such a good ground as a water pipe system, apart from all other factors coming in, such as electrolysis, which have to be guarded against on alternating current, but is not nearly as bad as on direct current.

Mr. E. V. Buchanan Mr. Chairman, might I just interject another question at this point? Has the author any knowledge or information of the resistance of the matter which is now used and commonly known as leadite?

Chairman: I think I can answer that question of Mr. Buchanan. Leadite is a non-conductor, and the only way you can overcome that

is to put in a wedge of iron to carry the current.

Mr. W. B. Buchanan: That was a point I had no knowledge of whatever. There is another point brought up about grounding the neutral at the services, or rather at the consumer's premises, and the resultant interference with the telephone operation. I don't know to what extent this would answer that question, but it is a general proposition if you get two paths for current, one an overhead ground wire that is in parallel with the telephone wire, that there is electro-magnetic induction between those circuits, and there is a possibility of interference with communication circuits. The paper that Mr. Merriman will give will cover interference at radio frequency, but there is a very large field of inductive interference between the power circuits and the communication circuits at all ordinary frequencies such as we use for power. That is one possible answer to the question. And another would be that by tying the ground to different potentials, one may go up or down with respect to the other and carry a circulating current through the pipe or impress voltage on the telephone circuit and there is a possibility of such complications under such conditions that it can only be suggested what might be the things to look for.

Mr. Phelp's experience with regard to grounding to the railway return, of course, is interesting, and it agrees quite well with some tests we have made on such voltages. I would suggest that your meter should be selected to tell you whether it is alternating or direct current components that are present. I have taken the measurements from a street railway track which was supposed to be the return circuit and normally at ground potential, and between that and a water hydrant on the side of the road, read 72 volts direct current voltage. So you begin to mix the thing up when you bond in with somebody else's property under conditions of that kind.

The Inside Story of Residence Wiring

By H. Shaw, Secretary-Manager, Detroit Electrical Extension Bureau

(Address at Convention of Municipal Electrical Utilites at Toronto, January 20, 1927.

IT rather amuses me to be asked, or given the opportunity, to present this little demonstration in Toronto for two reasons. First, it has to do somewhat with the Red Seal, and Toronto, as you all know, is the birthplace of the Red Seal idea; and Toronto is the one city on the continent that has led the entire field and bids fair to lead the field for some time to come in the Red Seal activity.

Another rather interesting or amusing thing to me about it is that this little demonstration that I am going to run through is, or was, really an afterthought. I will tell you something about the purpose of this thing so that you will have some patience with me while I go through it, and you will have an understanding of what it is all about.

As Manager of the Electrical Extension Bureau in Detroit, I am more or less concerned at certain times as to how I can best spend the industry's money and give them returns for the money spent.

Every year we have a very successful Builders' Show in Detroit and the Bureau always takes space in the Builders' Show and has to put on some kind of stunt or activity to reach the building public. It is patronized every year by about 150,000 people and it is a good stimulus for the building business and home ownership in Detroit. So in 1926 we were confronted with the same problem as previously as to what to use for the Builders' Show. My fieldman came to me and said: "How would it be if we built a booth and showed construction wiring in a house?" "Well," I said, "that sounds pretty good. Have you got any ideas on it?" Incidentally, our fieldman is an old-time electrical contractor so he went ahead and built a booth similar to this one, and I said: "Let's see how it works out."

I wandered up the first afternoon of the Builders' Show and this is about what happened—a couple would walk up and look at the sign on the top of the booth, they would step in and he would start talking about this or that, or something else, and others would come and look and walk away. Others would step up, and the conversation was still going on of a rather personal nature, so they moved on. So I decided that the booth, as we call it on the other side, was destined to be a "flop".

We wanted something to get a lot of attention from the public, so I said: "If you don't mind, I am going to stay right in that booth and see what I can do with it. I have an idea that I can tell a story about

this exhibit that will get over with the consumer. I think I can tell a story that they will like to listen to." So, I am going to attempt to tell you what I told them.

Now, this exhibit naturally wasn't built or designed with the idea of being an industry exhibit. I want you to feel that the public, at the Builders' Show, learned things about electrical possibilities and electrical wiring which they didn't know. We all know they don't know enough about it or they wouldn't live in the kind of so-called "modern" houses they do live in. I want you to put yourself in their position in listening to what I have to say, so that at any time you present an exhibit to the consuming public it will give you an idea of how it might be presented. So, if you will just bear with me, I will assume you are a crowd at the Builders' Show listening to somebody tell about electric wiring in your house.

This is one of the few exhibits in the building that has absolutely nothing to sell. We don't do electrical wiring. We don't sell fixtures. We don't sell wiring devices. We don't sell anybody anything. The purpose of this is to show you what goes in between the walls of a properly-wired home.

The average buyer of a home only sees the switch plates and the lighting fixtures. There is a great deal more goes to make a complete home than just the lighting fixtures and the switches. The switches are particularly important.

This particular type of installation on this side is known as armored cable. This type is known as knob and tube. Armored cable costs the electrical contractor more per running foot to buy than this type of construction does, but due to the fact that he can save in labor what he loses in material, you can buy in Detroit a BX job as cheaply as you can buy the knob and tube job. They both meet with the city requirements, insofar as safety is concerned.

This little device over here is probably unknown to 98 per cent. of home owners. When the lady has the hand iron plugged into this device, this bull's eye warns her that the current is on and if she is called to the front door and is away longer than she expected to be, the bull's eye will warn her that the current is on and all she has to do is shut off it and she won't find a hole burned in the ironing board. This device can be used with the convenience outlet part of it left off and if you place this at the head of the basement stairs the bull's eye will warn you that you left your basement lights on. It is an inexpensive device; has been on the market for years and the only reason more people haven't got it is because they don't know about it.

Here we have the kitchen ventilating fan. With one pull of the string you reverse its operation and it is drawing fresh air into the room. There have been kitchen ventilators on the market for a number of years. This is an improvement over the previous type. You will notice in the back that the ventilators come through. In the older type of fans these ventilators were operated by the current of air from the fan.

The disadvantage of that was that wind would raise these ventilators and let in a certain amount of cold air, dirt and dust. That is avoided by this lever which controls the ventilators from the outside. When the lever is in this position, the plates are open and the fan operates. When you are through using the fan, you simply switch the lever back and there is nothing from the outside that can open it.

These two devices on this side are the greatest improvements in residence wiring in the past ten years. These are the devices that hold your fuses. Everybody that lives in a house knows what a fuse is. If he doesn't he will find it out the first time the lights go out. In the so-called modern home that most of us live in today, when the lights go out, it is only necessary to get a match or a candle and go down in the dark basement and crawl over a coal pile, get a soap box and stand on it and unscrew a half dozen of these things and then you holler upstairs, "Are the lights on yet?" Then you take out some more and get cobwebs all over your hair. After a while you find the fuse you are looking for and you will fit in a new one. The purpose of these devices is to take the fuses out of the basement and put them on the first floor where they should always have been put. These devices can be placed in the rear hall or in the kitchen. They are a great improvement over the old way of arranging fuses. You will also notice that there is a place provided opposite each fuse to write in there the lights that are controlled by that fuse.

For example, we will assume that number one fuse controls your living room lights. You simply walk into the rear hall, open the door, take out the plug that you want and insert a new plug and you have your lights back again.

Another advantage is that you can place your hands over them without coming in contact with a live part. You don't need to remember the name of these. When you buy or build your home, ask to have your fuses placed on the first floor.

The Floor Plug

Here we have a little arrangement that has been on the market for a number of years and I don't think two per cent. of the home owners ever saw one. That is a floor plug. Everybody knows what a base plug is and some houses have them. It is what you use when you plug in your vacuum cleaner or any other electrical device. This thing serves exactly the same purpose as a base plug only it is used in the floor instead of near the base. This is the only practical way of bringing electrical service to a dining room table.

In a so called modern home, the only way to get electrical service is to stand on a dining room chair, unscrew one of your light bulbs and have the cord hang down over your table. This is unsightly and in time ruins your fixture. The other way is push the dining room table over against the wall and plug it in if you are lucky enough to have a convenience outlet to plug it in. The disadvantage of this method

is that if anybody gets up from the table and catches his toe in the cord, away goes the coffee pot on the floor.

I said a moment ago that the purpose of this exhibit was to show people what constitutes a properly-wired home. The average home is not adequately wired. I would like to give you all an illustration. You are interested in what usually happens when we move into the so-called modern home. Let's assume that all of you listening to me have just bought a new home. We have this nice home and it is "modern". We have made our payment and put our good money into it and moved in. If you will stretch your imagination a moment, let's assume this is the living room. All the furniture is in. Over here is a piano and a piano lamp and over here we have a table and a table lamp and over here is a chair and a bridge lamp. Somebody says, "How are we going to connect the piano lamp?"

"I hadn't thought about that. There should be some place in here to connect it. Look around."

And if you are real lucky over here you may find one of these convenience outlets. The piano is over here and the outlet is over there. We can't put the piano over there. So we will go and get one of these three-way businesses that the electric store sells and plug it in here and get some wire and tack it up here neatly and run it along the moulding and bring it down here and that is the way we will light our piano lamp. We will do about the same thing for the bridge lamp, only we won't have so far to run. By that time we are getting kind of disgusted with our new home and we decide we don't want the neighbors to know how bum a job we really did get so we will stick this wire under the rug and nobody will see it. Of course in six months we will have worn a spot across the rug but it takes us six months to find it out and by that time it is too late.

Who is to blame for all of this condition of wiring? The reason for this entire exhibit in the 1926 Builders' Show is to teach the people something about what should go into a properly constructed modern home. I might say that we were fortunate in having this particular plug over in this corner. Some living rooms don't have even one plug.

Like Water in Basement

It should not be necessary to wire a home that way. How many people in front of me would buy a house in which there was only one faucet and that was in the basement? And when you wanted water in the kitchen sink you bored a hole in the kitchen floor and stuck a piece of tubing down and brought the water up. You all laugh; that is funny; nobody would buy that kind of a house; but listen to this: the City Electrical Inspection Department in Detroit less than three months ago inspected some 250 occupied buildings. In 200 out of the 250 they found the conditions of wiring in the class with the plumbing I just described. They used every conceivable kind of wire with the possible exception of hay wire, and

the automobile industry put the hay wire business on the bum.

I said a moment ago that we had nothing to sell. We don't do electrical wiring nor sell fixtures nor sell anything. I will go a little further than that and say this: We have here a booklet containing twenty-eight pages of useful information for the housewife and for the home owner on the use of electricity. This is our Red Seal specification which covers the things that you will want to know about and all that you will need in the home that you are going to build. If you will fill out one of these tickets we will be very glad to mail you these pieces of literature. There is absolutely no string attached to it whatever. We are not giving lots or summer cottages or golf sticks. We are not compiling a mailing list. If you are interested in this literature, and will fill out these tickets, we will be glad to mail you this information.

We will go still further than that. If you are interested in building at this particular time we will be glad to go over your plans with you; we will discuss them with you; we will make suggestions which you may use or reject as you see fit. If you decide you want to make your home a Red Seal home, we will send our man out to inspect the installation after the roughing in is done or before the plaster is put on and we will send him back down after the job is completed and make another inspection and then if it meets with these requirements we will award this seal and also this certificate with the home.

There is no obligation or string of any kind or nature attached to this offer.

Some gent pipes up and says, "How do you eat?"

What you mean is where do I get the money to do it, and I am going to tell you.

We are supported by the local electrical industry. The electrical industry has learned that 95 per cent. of the people that buy or build a home today don't get what they ought to and what they thought they were going to get electrically and they don't find it out until they have bought the home and moved in and then it is too late. The purpose of this entire exhibit is to try and get people to think, to know something about the things that they should have in a modern home. Don't sign a contract with anybody for anything in connection with your new building until you know what you want electrically and then see to it that you get it.

If you will fill out these slips we will be very glad to mail you this literature and give you any other service that we can. Those of you in the back of the room who haven't heard what I said, if you will step up, I will be very glad to go through this talk again.

Merchandising Merchandise

By J. Arthur Nichols, Merchandising Manager, Hydro-Electric System, Windsor, Ont.

(Presented before Association of Municipal Electrical Utilities at Toronto, January, 20, 1027.)

CAST OF CHARACTERS

Manager—Mr. Wm. Brown.
Salesman—Mr. Bill Mitchell.
Credit Manager—Mr. Geo. Johnson.
Lady Customer—Mrs. Van Allen.

Scene: Salesroom of the Composite Hydro Shop. Desk at the left centre. Three washing machines at the right well down. Entrance at the right and entrance at left. Entrance in the centre advisable but not essential.

Mr. Johnson: Say, Mr. Brown, I want to ask you about an account I have here that has been running now some three months without any payment.

Mr. Brown: What is it? Merchandise?

Mr. Johnson: No, it's a lighting account.

Mr. Brown: Let's see it. Have you had a collector out?

Mr. Johnson: Yes, and it seems that they are in very hard circumstances. The man has been out of work for some time and has a family of small children and they state that they are quite willing to pay and will pay just as soon as they can get on their feet.

Mr. Brown: Better just let it ride along for a while until we see whether they come through or not.

(Mr. Mitchell enters from the left.)

Mr. Brown: Well, Bill, how goes the battle?

Mr. Mitchell: Oh, I don't know, boss. Sometimes I get pretty well fed up with this job.

Mr. Brown: Come, come now, this is no way for a good, live, red-blooded salesman to talk. What's the idea of all the sobbing? I never heard of you playing the Broken Hearted Hero before.

Mr. Mitchell: Well, I have done my best to keep my spirits up, but with the way you have us bound hand and foot here now, it is almost impossible to close a sale.

Mr. Brown: Why, what's the trouble now?

Mr. Johnson: What's the matter with you?

Mr. Mitchell: Terms.

Mr. Brown: Terms?

Mr. Johnson: Terms?

Mr. Mitchell. Yes, terms. Here we are supposed to adhere strictly to the regulation of 20% down payment on all sales and the Big Four Department Store down the street is offering any washing machine, vacuum cleaner, or range delivered on a down payment of $2.50. I have lost three of my best prospects in the last week simply because they did not have the necessary cash available at the

moment to make the down payment required by us.

Mr. Brown: We have gone into this question of down payments very thoroughly and we believe that even though we do lose a few sales on account of asking for large down payments we are much better off than we would be if we accepted a small down payment, because a large volume of business accepted on this basis always results in unlimited trouble for the Credit and Collection Department.

Mr. Johnson: Yes, Bill, if you just knew some of the trouble we have trying to collect the money from these people that pay small down payments you could realize quite easily that the small down payment business is not right, and anything less than 20% of the total price as a down payment is not enough to protect us to any extent in case of repossession during the first few months.

Mr. Mitchell: That may be all very well in theory but you don't see the Big Four Department Store going out of business, do you? And they have accepted these small down payments for the last two years.

Mr. Brown: (To Mr. Johnson) Bill here feels that we are placing an unfair handicap on our Sales Department by asking for such large down payments.

Mr. Mitchell: Yes, I sure do. I know doggone well that our competitors who are accepting smaller down payments have the edge on us in every respect. I spent two hours this afternoon talking to a lady. She tells me that she is in the market for a good washing machine and I believe that she has called on two or three of our competitors already. She is coming in here this afternoon.

Mr. Brown: Well, I believe, Bill, the trouble lies not in the terms we have to offer but in the method employed by you salesmen. I believe if you talk to the customers properly you can make them see that we are simply attempting to operate our business on a good sound business-like basis.

Mr. Johnson: Yes, there is no doubt but what the chief is exactly right. We cannot accept these small $5.00 down payments. If people cannot afford to pay $20.00 down on a $100.00 range they have no business buying the range, and I believe that the trouble lies mostly with the salesmen. You seem to have developed into order takers with no particular ability along the line of keen salesmanship.

Mr. Mitchell: Well, all I can say is I'd like to see you handle some of the customers I get up against every day. It seems to me that the credit men and managers in establishments of this kind sit back in tilted chairs behind glass doors and dope out plans and so called policies which if they were strictly adhered to would drive 90% of the salesmen into the cuckoo house in thirty days. As a matter of fact if something isn't done very shortly to enable us to meet competition with one competitor in accepting down payments of 19c. and another one donating a silver plated diamond studded ice-cream cone as a premium with every

purchase, I am going to wind up in the booby hatch myself.

(NOTE): During this speech Mitchell has become more or less angered but Johnson and Brown laugh it off, apparently enjoying the situation quite heartily.)

Mr. Mitchell: I had a case last week of a woman who was practically sold on one of our washers, but she insisted that we should make her some allowance on her old water power machine, which of course I was unable to do on account of our very fixed policy, so at the wind up of the scene I found the Big Four Departmental store salesman and the salesman for the Genuine Electric Company in very keen competition with me on the side line as an interested spectator and finally the deal was closed by the Genuine Electric Co., who sold her a $132.00 washer with a down payment of $2.25—18 months to pay the balance and an allowance of $17.50 for her water power machine, and they delivered with the washer as a premium $8.00 worth of collapsible, non-shrinkable, clothes pegs.

Mr. Johnson: (Shakes his head and exits right.)

Mr. Brown (laughingly): Aw, don't be so downhearted, Bill. You are in the dumps today. Better take the rest of the day off. You'll come back feeling better to-morrow morning.—(Exit Mr. Brown.)

(Enter Mrs. Van Allen.)

Mr. Mitchell (Suddenly growing very affable): How do you do, Mrs. Van Allen?

Mrs. Van Allen (gushingly): I certainly have had an awful time getting here. Just as I was all ready to leave I discovered that my car had a flat tire and I was obliged to come on the street car and I waited what seemed to be an hour for a car and when it finally did come it was the slowest car I've ever been on in my life, and when I got off down town I met Mrs. Smirk, and really, Mrs. Smirk is the awfullest talker I ever met. She just talked and talked and talked until I thought I'd never get away from her, but finally I told her that I was hurrying to see a sick friend, at least a friend who would be sick if I did not get there, and so now here I am, and I'm just tired out.

(The above speech must be made rapidly in one breath if possible.)

Mr. Mitchell: Yes, Mrs. Van Allen, we all know of course that you are a very busy woman, and I will try to show you our washers and explain what I can in as few minutes as possible. (They gradually walk toward the washers.)

Mrs. Van Allen: Say, do you know that I have looked at so many washers and had so many offers of various kinds that really I am quite confused if you know what I mean. But I was talking to my husband and it seems that he and Mr. Brown, your manager here, have played golf a lot together and he insisted that I come here to buy.

Mr. Mitchell: I think you'll find that you always get fair treatment from the Hydro. We really have the interest of our customers at heart and are trying all the time to keep our service right up to the best and improve it whenever possible.

Mrs. Van Allen: Now where is the motor on this machine?

Mr. Mitchell: We'll come to that in a minute. First, let me point out the principle on which this machine works. You will notice......

Mrs. Van Allen (interrupting): There is a motor on this machine, isn't there?

Mr. Mitchell: Oh, yes, I'll show it to you in a minute. Now here is the way this machine will wash your clothes......

Mrs. Van Allen: It won't wash my clothes unless I buy it.

Mr. Mitchell: I realize, Mrs. Van Allen, that nothing I can say will influence you, because you are quite capable of deciding, but in fairness to ourselves I think it only right that I should tell you a few things about it.

Mrs. Van Allen: That's just what people have been doing for a week—just telling me things (most of which I don't believe). Well, if you are going to show me about it, go ahead. Where is the motor?

Mr. Mitchell (biting his lip) (Tipping the machine slightly): There is the motor. That is one of the best made, too.

Mrs. Van Allen: What make?

Mr. Mitchell: Speed Electric Co., and it's a full ¼ horse power.

Mrs. Van Allen: Why, my dear man, the salesman from the Genuine Electric Co. tells me that these machines are all equipped with 4 h.p. motors.

Mr. Mitchell: Really, Mrs. Van Allen, I think you are mistaken. It would be......

Mrs. Van Allen (interrupting): And they also said that it was reversible.

Mr. Mitchell: Reversible?

Mrs. Van Allen: Yes, there is a little rig-a-ma-jig that you press and the motor runs the opposite way.

Mr. Mitchell: I think you must have misunderstood......

Mrs. Van Allen: Well, your wringer has to run the opposite way at times so the motor must reverse.

Mr. Mitchell: I will show you how that is done. You see, in the wringer head here there is a set of reversing gears operated by this control (starts machine up and demonstrates) that you can wring in either direction.

Mrs. Van Allen: Well, you wouldn't want to wring back in the machine after they had been wrung out. Would you or do you put the clothes through the wringer first to flatten them out?

Mr. Mitchell (holding his temper): No, no, but you see this wringer can be swung over the laundry tubs so that you can be wringing a batch of clothes from the rinse water to the blue water at the same time that another batch is being washed in the machine.

Mrs. Van Allen: Oh, I see—that wringer doesn't run very fast, does it?—(places fingers on rolls, gets them caught, and screams).

Mr. Mitchell hits safety release and in so doing nearly knocks her over. Close of scene shows Mitchell very worried and upset and Mrs. Van Allen's hat is knocked sideways. She holds her hand and moans.

Mrs. Van Allen: I wouldn't have

that machine at any price. Show me this other one.

Mr. Mitchell (shaking his head in a discouraged way): Yes, Mrs. Van Allen. Now this machine operates on the well known agitator or gyrator principle.

Mrs. Van Allen (straightening her hat): I think that other one is somewhat of an agitator.

Mr. Mitchell: This is believed to be one of the fastest methods of washing. You see, the action of this machine keeps the water in constant agitation and the suds is forced back and forth through the clothes.

Mrs. Van Allen: How fast does this motor run?

Mr. Mitchell: This agitator reverses 96 times per minute and......

Mrs. Van Allen: And how long does it take to wash clothes?

Mr. Mitchell: Well, that depends largely on the condition of the clothes. Flannels, woollens, 4 to 5 minutes; lace curtains, 3 to 5.

Mrs. Van Allen: I mean dirty clothes. If they weren't dirty they wouldn't need washing.

Mr. Mitchell: The manufacturers of this machine claim that it will wash the diritest clothes in fifteen minutes.

Mrs. Van Allen: Well, then, why not run it twice as fast and wash them in half the time and then clothes only slightly soiled could be washed in about 2 minutes.

Mr. Mitchell: Well, you see, Mrs. Van......

Mrs. Van Allen: Is this all the types you have?

Mr. Mitchell: No, but I believe this machine will do your work. We have sold a lot and they are all doing a good job. I can heartily recommend it.

Mrs. Van Allen (spying a third washer): Tell me about that one.

Mr. Mitchell: (They move) This machine works on an entirely different principle. This is known as a cylinder washer. The clothes you see are placed in this cylinder and then the cylinder reverses in the water. This is one of the oldest methods of washing known.

Mrs. Van Allen: Is this a better machine than the other one?

Mr. Mitchell: That is a matter of opinion.

Mrs. Van Allen: What is the price of this one?

Mr. Mitchell: $164.50.

Mrs. Van: And that one (No. 2).

Mitchell: $158.00.

Mrs. Van: And this one? (approaches No. 1 and then suddenly remembering the trouble with it, draws back with a start).

Mitchell (turning away to conceal a grin): $190.00.

Mrs. Van: Which is the best?

Mitchell: Well, this is a good machine (No. 3). It washes fast and takes a standard 6 sheet size washing and carries a 1 year guarantee.

Mrs. Van: What about that one (2)? Doesn't it hold as much?

Mitchell: Just about the same.

Mrs. Van: Isn't it as fast?

Mitchell: Yes.

Mrs. Van: Isn't it guaranteed?

Mitchell: Yes.

Mrs. Van: How long?

Mitchell: One year.

Mrs. Van: Well, what's the difference?

Mitchell: Well, you see, Mrs. Van......

Mrs. Van (interrupting): Is this machine (3) as good a machine as the one the Big Four Store sells?

Mitchell: Oh, yes, this is one of the best machines made.

Mrs. Van: Well, isn't the Big Four?

Mitchell: Yes.

Mrs. Van (looking at him): And there you are. The more I enquire the less I know.

Mitchell: Now, Mrs. Van Allen, why not put a stop to this worrying by deciding right now on one of these machines.

Mrs. Van: I believe I will, but which one shall I have?

Mitchell: Which one do you like the best?

Mrs. Van: Which do you think is the best?

Mr. Mitchell: I believe this one (2) will suit your requirements.

Mrs. Van Allen: I don't know whether I should buy a machine from the Hydro or not. Sometimes I think it is all wrong.

Mr. Mitchell: Why, what do you mean, Mrs. Van Allen?

Mrs. Van Allen: Well, I just wonder whether the Hydro has any right to engage in selling electrical appliances or not. This Hydro System is a municipal institution operating on the people's money and it hardly seems fair that the independent electrical dealer should pay his good money in taxes to support a business which is running competition with his own business.

Mr. Mitchell: Well, Mrs. Van Allen, there are several ways of looking at this, of course, and......

Mrs. Van Allen: I know that the attitude of some of the independent dealers here is that they could do a lot more business and make a lot more money if it were not for the fact that this Hydro Shop is operating almost next door to their place of business.

Mr. Mitchell: That may be all very well, Mrs. Van Allen, but you should consider that when Hydro was first instituted, the electrical business as a business practically did not exist and it is due to the efforts of Hydro to popularize the use of electricity in the home that the appliance business has grown to the size it is to-day and it is absolutely wrong to say that the Hydro Shops are opened in competition with the independent dealers. The Hydro Shops were opened before there were such a thing known as independent dealers, and the dealer of to-day has opened his shop in order to take advantage of and cash in on the business which has been created by Hydro. I venture to say that even if the Hydro Shops go out of business the dealer will be the first one to holler.

Mrs. Van: Alright, I'll take it.

Mitchell: Yes—(producing contract form). Now, when shall I send it.

Mrs. Van: To-morrow, but say now, you say the price is......

Mitchell: $158.00.

Mrs. Van: And what discount if I pay cash?

Mitchell: Well, this is the cash price, Mrs. Van Allen.

Mrs. Van: Why, what are you talking about? The Big Four and Genuine Electric Co. both quoted

me 5% discount if I pay cash within 30 days.

Mitchell: Yes, but you see, they quote you the time price. If we quoted you the time price on this washer, which is $169.00, we could then give you a discount of $11.00 for cash, which is more than 5%.

Mrs. Van: Then you have quoted me one price to get me to buy, and now you are attempting to raise it on me, eh?

Mitchell: (Shoves hands in pockets and walks to far side of stage). (Aside) "And then these damn credit men refer to us as order takers." (Coming back) Can't you see, Mrs. Van Allen, that we are trying to be absolutely fair. We quote you the cash price and if you pay cash then that price stands, but on deferred payments we add regular bank interest of 7% to the unpaid balance.

Mrs. Van: Well, I don't suppose it matters, as I don't intend to pay cash anyway.

Mitchell (with a disgusted look): Alright, then; how shall I make out this contract?

Mrs. Van: Well, what will you allow for my old water power machine?

Mitchell: Oh—eh—well, er—you see, we are not permitted to take used machines in exchange.

Mrs. Van: Why not? I have had three offers for my old machine and if they can do it, why can't you?

Mitchell (aside): I wish the man who thinks the trouble is with the salesmen was here now.

(Enter Mr. Brown.)

Mitchell: Here's Mr. Brown now, Mrs. Van Allen. Mr. Brown, this is Mrs. Van Allen who is buying a washer from us.

Mrs. Van: I don't know whether I am or not. Is there any reason why the Hydro can't allow me the same for my old water power machine as the other dealers would?

Mr. Brown: Well, you see, Mrs. Van Allen, it is against our policy to take any used merchandise in exchange except in extreme cases, and of course we could not think of accepting a machine which is not electric.

Mrs. Van: Yes, uh-huh, and its against my policy to pay you $15.00 when the other stores offer to save it for me.

Mr. Brown: Well, couldn't you, by putting an ad. in the paper, dispose of this old machine yourself?

Mrs. Van: Maybe I could, but I don't have to. Your competitors offered to do it for me and besides, that old water power machine isn't worth 15 cents.

Mr. Brown: I don't see any reason why we should take it then. It isn't even electrical.

Mrs. Van: No, and your own machines are not *very* electrical. The only electrical part is that little tiny black motor stuck away under the tub. I believe this washer business belongs to the other stores and I think I'll go and buy it there.

Mr. Brown (slightly irritated): Well, that's your privilege, Mrs. Van Allen. We certainly could not think of taking that machine in. (Exits with a forced smile.)

Mr. Mitchell (aside): There you are, damn it. Now I've got to make the whole sale over again. (Coming

to Mrs. Van Allen) Now, Mrs. Van Allen, don't pay any attention to the boss. He wanders around with his head full of transformers and distribution and high tension and all that bunk and he doesn't understand merchandising but I do, and I know that what you say is correct and I'll tell you what I'll do. You want a washer and *I want to sell it to you*, so you give me the order on our regular terms and I'll guarantee to sell your water power within three months for fifteen dollars net to you. That's fair, isn't it?

Mrs. Van: Yes, it is, and do you know, I believe I'll do that.

Mitchell (writing up order): Your initials are?

Mrs. Van: T. A.—Mrs. Thos. A.

Mitchell: Yes, now if you'll just sign this please. (Hands her contract and pen.)

Mrs. Van: (Reading) What's this $30.00 cash and $12.00 monthly? No, I won't pay $30.00 cash. You see, the only reason I'm not paying cash is that I am going to pay for this washer out of the allowance I have to run the house on. I don't want to draw money out of the bank, so I am going to pay $15.00 down and $15.00 a month. That will just pay it in a year.

Mitchell: Well, I know that our Credit Department will kick, but I'll do my best to get it through for you. (Changes contract.) There, how is that?

Mrs. Van Allen reads contract carefully. Mitchell stands anxiously fidgeting beside her. Then she deliberately takes up pen, signs order, opens purse and hands him $15.00.

Mitchell (fervently): Thank you Now I'll just receipt this. (Does so.)

Mrs. Van: Now, will you send some one to show how to operate the machine?

Mitchell: Yes; I'll be out in the morning, Mrs. Van Allen.

Mrs. Van: Thank you—Goodbye.

Mitchell: Goodbye, Mrs. Van Allen. Thank you.

Mrs. Van Exits. Mitchell sinks into a chair completely exhausted and fans himself with contract while he gloats over the bills clutched in his hand.

Mitchell: Well, I've got it half sold, anyway. Now, if I can just sell this contract to that credit man Johnson, then I've earned my commission provided nothing else happens.

(Enter Johnson.)

Johnson: Hello, Bill, you look tired.

Mitchell: I am tired.

Johnson: How come?

Mitchell: I just had 10 rounds with a hard customer, 3 washers, a clearly defined policy and a rigid credit ruling and being just an order taker it was naturally rather strenuous. You see, Mr. Johnson, I have such a weak personality that unless the customer walks in and presses a roll of bills in my hand and implores me to please send out a washer, I don't score. Here (hands him contract and money), will you please look that over and call up all the credit bureaus in the province; then look this man up in Dunn's and Bradstreet's; then hold a long distance conference with H.E.P.C. and finally after the customer has bought a

machine some place else, tell me alright, to go ahead.

Johnson: Listen now, Bill, you take the wrong view of these things. I am paid by this system to look after credits and one of the rulings handed to me is that the cash payment on all purchases must be at least 20% of the price. Then you hand me a contract like this with less than 10% down. What am I to say? You know that I can't accept this. Why didn't you talk to this woman and explain that we must have a down payment of at least $30.00.

Mitchell (sarcastically): Well, you see, I didn't get much chance to talk. She just ran in in a hurry and handed me the money and signed the order and asked me to send the washer.

Johnson: Who is this T. A. Van Allen?

Mitchell: Why, he is Thomas A. Van Allen, manager of the Purified Milling Co. His name is on the board of directors' list of half the big outfits in town, and the only reason his wife is buying this on time is that she wants to pay for it out of her allowance.

Johnson: Well, this down payment is N. G. You'll have to get another $15.00. If I ever let that contract go through, those H.E.P.C. auditors will be on me like a tent.

Mitchell: Say, listen. I can't go back to this woman and ask that. Their credit is good. She has paid a down payment 3 times as large as any of our competitors require.

(Enter Mr. Brown.)

Johnson: We'll ask the boss about it. (To Mr. B.) Here is another of these low down payment contracts, Mr. Brown. I have told Bill that we can't accept it, but it's the same old story. He wants to run the Credit Department.

Brown: What is the amount of the contract?

Johnson: $169.00, and the down payment is $15.00—less than 10%.

Brown: No, Bill, that's all wrong. We must have a larger cash payment. Do you think this woman is good for this amount?

Mitchell: I know she is. Her husband owns half of this town. He's on the board of directors of about two dozen of our best companies.

Brown: Well, then, why doesn't she pay cash?

Mitchell: Because she wants to pay this out of her household allowance.

Brown: Well, she can at least pay $30.00 down if her husband is worth what you say he is. We simply must have larger down payments and if you go and explain in detail to this woman just what our policy is and why.......

Mitchell: Oh, damn our policy and everything else. This woman is a very peculiar type. Her credit is good and she knows it's good and if I ever open up this payment question again, the deal will be off. Tom Van Allen is worth money and his rating is high and there is no reason......

Brown: Is that Tom Van Allen of the United Mercantile Co.?

Mitchell: That's the man.

Brown: (Turns to Johnson) I know him well. We play golf together. He's good as the wheat.

Johnson: All the more reason

why we should insist on a larger down payment.

Brown: Sure, Bill, you go and explain your position and you will have no trouble getting a larger payment.

Mitchell: Explain? Why, say, I've spent hours and lost pounds of weight trying to explain things to this woman and I can't do any more. If I just mention it to her she'll go up in the air a mile a minute.

Brown: Ah, don't be afraid.

Mitchell: (A light in his eye) Say, Mr. Brown, you play golf with Mr. Van Allen?

Brown: Yes.

Mitchell: You know him very well?

Brown: Yes.

Mitchell: Well, I don't know him at all, and I just made the acquaintance of his wife to-day. Why not let us make use of your acquaintanceship?

Brown (doubtfully): Yes.

Mitchell: Yes—you call up Mr. Van Allen and just explain our policy and ask for an additional $15.00 cash to make ourselves secure in case he does not pay the balance, and then . . . . . .

Brown (interrupting and just a little annoyed): Damn it all, Johnson, you know sometimes I think our rules are a little rigid.

Mitchell (taking advantage of the situation): Rigid? Ridiculous as blazes. You know you can't call him up and ask him for $15.00 or he'll think you're a piker. Yet you know his credit is A.1. Now what's to be done?

Brown (To Johnson): Let this contract go through as it is.

Mitchell: I've made another sale.

Johnson: (O.K.'s contract and hands it to Mitchell.) Alright, Bill, turn the money in to the cashier and put the contract through in the regular way.

Mitchell (still smiling): Thanks.

(Enter Mrs. Van Allen hurriedly.)

Mrs. Van: Oh, have you sent my washer yet?

Mitchell: Well, no, I don't think it has left yet.

Mrs. Van: Well, I have the greatest news. I was just talking to mother and she's going south for the winter and as she is putting her furniture all in storage, she has offered to give me her washer. I guess we'll just call our deal off.

Mitchell gazes in a state of stupefaction for a moment. Mechanically hands her the $15.00.

Mrs. Van: Thanks so much for your attention in showing me the machines. (She walks to the door.)

Mitchell teeters on his heels, still gazing at her, then Will Brown and Johnson laugh. He slowly raises his hand to his forehead as the curtain falls.

Further Convention Reports Will Appear In March Number

Ontario Municipal Electrical Association

The Secretary's Report

To the Officers and Members of the Ontario Municipal Electric Association.

Gentlemen:—

Our last Annual Meeting, held in Toronto on the 21st January, 1926, was held in conjunction with the Association of Municipal Electric Utilities and exceeded in point of attendance any previous convention.

The Luncheons and Dinner were attended by almost, if not all, delegates, but the attendance at the Business Sessions was not quite so good, which, while not perhaps just what the Officers and Executive would prefer, seems to show that the general membership is satisfied with the conduct of affairs and with the Directors chosen by them.

The Summer Convention was held at Bigwin Inn, Muskoka, and, considering the distance and the extra time required to attend same, was a remarkable success and provided an excellent outing, but the other attractions there were responsible for even smaller attendance at the Business Sessions than at the last Annual Meeting.

However, both these Conventions offered a great opportunity for the getting together of men from different sections of the Province and the exchange of different ideas and the discussion of various municipal problems from many angles and from this standpoint as well as from the publicity given, these conventions are particularly valuable and helpful in the continued progress of electric distribution.

A general Executive Meeting was held in Toronto on June 1st, when the following matters were discussed and action taken in respect to same.

A. The contract entered into by the Hydro Electric Power Commission for a supply of Power from the Gatineau.

B. The proposed Pension and Retirement Fund plan for the Municipal Commissions.

C. The proposed St. Lawrence development on which the engineers had not then reported.

D. The necessity of holding a series of public meetings in Eastern Ontario and discussing with public men in that district the power situation of the present and future.

E. The necessity of keeping in touch with the Dominion and Provincial Governments so that both these public bodies may better understand the power needs of the Ontario Municipalities, so that we may at all times have their sympathetic co-operation.

The Committee on Pension and Retirement presented their report to the Summer Convention and were reappointed and are still working on

this and hope to have a definite report ready in the near future.

The following resolutions were passed by the Executive:—

> THAT this Executive representing more than three hundred Municipalities using Hydro power in the Province of Ontario desires to place on record our appreciation of the foresight of the Chairman and Members of the Hydro Electric Power Commission in taking advantage of the opportune moment in making such an advantageous contract for the transmission to the Province of an adequate supply of electric energy which will relieve us from the threatened power shortage next year due to the delay in the development of the St. Lawrence, and we also desire to place on record our appreciation of the co-operation of the sister Province of Quebec in this matter of such great importance.

In addition to the above, negotiations have been going on between the Prime Minister of Ontario, The Hydro Electric Power Commission of Ontario, and the Government of Quebec with respect to a devlopment at the Carillon Falls on the Ottawa River which we believe, if carried out, will be of great benefit to the power users of this Province.

A number of meetings were held in Eastern Ontario during the summer and a number of informal visits paid to various Municipalities in that section which we believe will have the effect of bringing the Eastern and Western parts of Ontario into closer relations.

It was deemed advisable to present our views on several of these questions to the Dominion Government and to again urge the elimination of the proposed tax on the Ontario Power Company's old contract and we at all times received a most courteous and considerate hearing. There has been considerable correspondence with several public service bodies in the United States that are actively interested in the St. Lawrence Development and the elimination of the Chicago Water Steal and several of our Officers have attended some of their meetings in the cities close to the Great Lakes.

We still find that it is absolutely necessary to be on guard all the time, for now, as in the past, Eternal Vigilance is the price of safety and every little while someone attempts to interfere with Municipal Rights; only this summer at a meeting of a public service organization in the City Hall, Toronto, at lunch hour when only a comparatively small number were present, a resolution was carried through approving of the development of the St. Lawrence and the cost to be paid for by the power users.

The Election of Officers will take place at this meeting and all members are urged to take an active interest in this as in other matters that may come before this session.

All of which is respectfully submitted.

T. J. Hannigan,
Secretary.

Minutes of Annual Meeting

The meeting was called to order at 2.15 p.m., January 19th, President C. A. Maguire in the Chair.

The Minutes of the last Annual Meeting which had been printed and distributed were adopted on motions of P. W. Ellis, Toronto; J. W. Oakes, Guelph.

The report of the Executive Committee was read by the Secretary and adopted on motion of W. Ellis, Hamilton; August Lang, Kitchener.

The President appointed the following as a nominating Committee:

P. W. Ellis, Toronto,

Fred Newman, Picton,

Col. Green, St. Thomas.

The Financial Statement was presented by the Treasurer and adopted on motion of W. Walsh, East York; W. K. Sanderson, St. Thomas.

President Maguire then addressed the meeting as follows:—

"The most important thing facing the Municipalities of Ontario today is the preservation of their rights in the Public Ownership of the Waterpowers of this Province and in view of the attitude of certain corporations and certain public men, I may say to you that the Hydro Electric Power Commission of the Municipalities are entering upon a very serious time. If there is a human side to the Federal Government, and I think there is, it would surely respect the Public Ownership Enterprise of Ontario. When I see the statement made by Mr. Sifton, I laugh. Recently he is reported as saying: 'Surely the Hydro Electric Commission is not going to enter into an agreement with the Montreal Interests at Carillon'. I would like to ask what interest the Siftons, father and son, have shown in the people of Ontario. When the agreement is announced, the people of Ontario will be satisfied, and if it so happens they are not satisfied, then no agreement will be entered into with the Carillon interests.

"Certain interests are endeavoring to secure the Georgian Bay Canal Charter. No Government claiming to represent the people can permit certain individuals to hold a charter for 20 years. It is impossible to think that any corporation should say: 'We want to build the Georgian Bay Ship Canal.' What killed the All-American route was that it was too much canal. From the point of view of navigation, the canal is too costly. It is power that is wanted. We say Provincial rights must be maintained in Ontario. We say it is not fair that private corporations after buying a charter granted 20 years ago, should be permitted to compete against the people of Ontario. We do not think that it is possible for the Government to commit such an atrocity."

Mr. Maguire declared that public ownership in Ontario had nothing to fear but insidious propaganda, which was being circulated by self-interested parties. He said public ownership of power in Ontario was being subjected to a careful study by the people of New York State, and remarked that some years ago no one would have thought that the Governor of New York State would have appealed to the people on a

public ownership of electric energy program.

"We must be on the alert, we must protest and we must assert our rights as shareholders in the Hydro Electric Commission. The Commission says it is your duty to go to Ottawa and say that no one has a right to interfere with Provincial rights. Lobbying is going on and influence is being exerted. If Provincial rights are not regarded, your Government will send a call from one end of the Province to the other, but I do not believe there is a public representative who would destroy what the people of Ontario have built."

Referring to the case which was before the United States Supreme Court, Mr. Maguire stated that seven Attorneys-General of as many States had expressed the opinion that Congress could not interfere with the clause respecting waters between the United States and Canada without the consent of both parties. He said it was hoped that the decision of the Supreme Court would put an end to the possibility of water-diversion from the Great Lakes. The permit granted in 1909 to Chicago was on the understanding that a diversion would not impair navigation, he stated.

Mr. Maguire said it had been once stated that if Sir Adam Beck could have been removed from the Hydro Electric Commission a good deal could be accomplished. He added that Sir Adam was told he should not bother with the St. Lawrence waterways scheme, that if he took it up it would shorten his life and it was suggested to him that if he left the scheme alone there would be no further opposition to the Hydro Electric Commission.

In concluding his address, Mr. Maguire said the "interests" were bitter. He contrasted their attitude with that of the Hydro Electric Commission which was given the power to expropriate, but had at all times been willing to negotiate for the purchase of private plants rather than exert the authority conferred upon it by the Legislature of Ontario.

Under General Business the following resolutions were adopted:—

Renew and reaffirm our previous resolutions, commend Ontario Government Policy, that no leases be granted to any private parties or corporations to develop or operate any waterpowers in Ontario.

That we memorialize Dominion Government to refuse any renewal of lease to develop Georgian Bay Canal or any waterpowers in connection therewith.

Resolutions *re* development of St. Lawrence:—

Commending action of Ontario Government and Hydro Commission in the contract for power from the Gatineau and the negotiations for power from Carillon Falls on the Ottawa.

Preparation of pamphlet explaining advantages of being members of Association.

That it is considered advisable that the incoming Board arrange a special meeting of Commissions and Members of Council.

Recommendation to Convention Committee that Summer Convention be held at Niagara Falls and that Hon. Al. Smith, Governor of New York State, be invited to address Convention.

A general discussion took place relative to the 13th Power Bill, some of the principal speakers being Mr. J. E. Gafer, Ingersoll; Mr. Bradburn, M.P.P., Peterboro; August Lang, Kitchener; P. W. Ellis, Toronto; W. K. Sanderson, St. Thomas.

The nominating Committee's report was presented and adopted on motion of P. W. Ellis, Toronto; Col. Green, St. Thomas.

Moved by Mayor Handford, St. Thomas,

Seconded by Mayor S. E. Brady, Ingersoll:

That the thanks of the Association be extended to President Maguire for his excellent address and the valuable work he is doing on behalf of the Municipalities.

Meeting adjourned 4.45.

Association of Municipal Electrical Utilities

Auditor's Report

January 18th, 1927

Mr. R. H. Starr,
President,
Association of Municipal Electric Utilities of Ontario.

Dear Sir,—

We beg to advise you that we have audited the books of the Association of Municipal Electric Utilities for the calendar year 1926, and find that the cash received and recorded by the Treasurer agrees with the Secretary's statements. The disbursements are supported by vouchers duly authorized and passed by both President and Secretary, and the cash balance is in accord with the account at the bank.

We respectfully submit herewith statement of Receipts, Disbursements and Assets.

Yours very truly,
(Sgd.) R. C. McCollum,
W. G. Pierdon,
Auditors.

Report of Committee on Accident Prevention and Health Promotion

Your Committee begs leave to report as follows:

During the year, meetings of the Committee were held at various times and a plan of action was developed very much along the line of the work in other years. At the Convention at Bigwin Inn, Mr. V. A. Sinclair, Chairman of the Workmen's Compensation Board, was asked to speak in regard to Accident Prevention and the Workmen's Compensation Act. Presentation of this subject by Mr. Sinclair was very much enjoyed by all present. Arrangements were also made that a showing of the film, "Someone at Home," was given. This film, as is generally known, was completely developed in Canada and shows some of the work of the lineman.

STATEMENT OF RECEIPTS, DISBURSEMENTS AND ASSETS FOR YEAR ENDING DECEMBER 31st, 1926.

GENERAL ACCOUNT

Receipts

Cash in bank, Dec. 31, 1925		$ 279.87
Membership Fees—		
Utilities (154)	$1,213.00	
Commercial (37)	370.00	
		1,583.00
Convention Dinners		1,833.00
O.M.E.A. Convention		125.00
Interest earned on bond		27.50
Interest earned on deposits		9.78
Surplus from Entertainment Account		51.65
		$3,909.80

Disbursements

Convention Expenses—		
Dinner	$1,501.00	
Entertainment	197.60	
Expenses	228.53	
Badges	107.13	
Printing	251.99	
Reporting	202.10	
		$2,488.35
Travelling Expenses		249.75
General Printing		158.22
Postage Account		40.92
Bank Exchange		15.90
Interest on Overdraft		1.67
Lamps for Projector		18.06
Salaries		250.00
BALANCE		686.93
		$3,909.80

ENTERTAINMENT ACCOUNT

Receipts

Donated by Sundry Manufacturers	$ 295.00
	$ 295.00

Disbursements

Articles Purchased	$ 243.35
Unexpended balance to General Account	51.65
	$ 295.00

ASSETS

Cash in Bank		$ 686.93
Dominion of Canada 5½% 1934 bond (par value $500.00) purchase price		513.50
Interest Accrued to December 30th, 1926		2.29
Lantern & Fixtures	$243.45	
Less 5% for 7 years written off	85.19	
		158.26
		$1,360.98

Work in Accident Prevention is for the most part being satisfactorily carried out in the various municipalities, but your Committee wishes to again emphasize the fact that to successfully prevent accidents needs the wholehearted and sincere and definite support of the local Commissions, the local manager, supervisory officials and all the men.

A great portion of the cost of the accidents is borne by the local Commissions and it must be realized that without the leadership of them in this work, very little success will be achieved.

Your Committee stands ready at all times to be of any assistance that it can be in solving the problems of the Commissions, if they are presented to it.

Signed on behalf of the Committee.
(Sgd.) CHAS. T. BARNES,
Chairman.

Report of Rates Committee

The President and Members
of the A.M.E.U.

Your Rates Committee report that we have not held any meeting since the Summer Convention, but while seemingly inactive during the year, we, as a committee and individually, rendered considerable assistance to the Engineers of the Hydro Electric Power Commission who had the revision of the rates in hand. We therefore claim some credit at least for the new system of rates recommended by the Commission and which we believe has been adopted by most of the municipalities.

We think the new system of charge in both Domestic and Commercial lighting is more equitable for present conditions and lends itself to ready adjustment as the conditions warrant.

Yours respectfully,
(Sgd.) J. G. ARCHIBALD,
Chairman.

Minutes of the Convention

The twentieth semi-annual convention of the Association of Municipal Electrical Utilities was held at Toronto on January 19th and 20th, 1927.

At 12.30 p.m. on Wednesday, January 19th, the Association, together with the Ontario Municipal Electrical Association and the Electric Club of Toronto, met for the first convention luncheon, when Hon. Dr. F. E. Godfrey, Minister of Labour and Health of Ontario, gave an address.

The first session of the convention opened at 2.30 p.m. with the President, Mr. R. H. Starr, in the chair, who gave a short address welcoming the delegates.

The following reports were presented and adopted:

The Auditors' Report, read by the Secretary.

The Report of the Committee on Accident Prevention and Health Promotion, read by Mr. C. T. Barnes, Chairman of the Committee.

The Report of the Merchandising Committee, read by Mr. G. J. Mickler, Secretary of the Committee.

The Report of the Rates Committee, read by Mr. J. G. Archibald, Chairman of the Committee.

Mr. F. W. Peek, Jr. Engineer of the General Electric Company, Schenectady, N. Y., gave a talk on "Lightning" which was illustrated by diagrams, slides and moving pictures. Discussion following Mr. Peek's address was by Messrs. J. W. Purcell, V. S. McIntyre, R. H. Myers, E. I. Sifton, H. J. McTavish, J. G. Jackson, S. E. M. Henderson, R. H. Martindale, and H. C. Don Carlos.

The scrutineers, Messrs. T. R. C. Flint and D. T. Flannery, announced the result of the ballot for officers for the year 1927, being as follows:

President—J. J. Heeg,
Vice-President—J. G. Archibald,
Secretary—S. R. A. Clement,
Treasurer—D. J. McAuley,

Directors (from the membership at large)—W. R. Catton, O. H. Scott, V. S. McIntyre*, and J. E. B. Phelps*.

*Mr. McIntyre and Mr. Phelps were reported to have received the same number of votes. As only three directors were to be elected, it was decided that a coin be tossed to decide who was to be the third director. On this being done, Mr. McIntyre was declared elected.

District Directors:
Niagara District—J. G. Jackson,
Central District—C. T. Barnes,
Georgian Bay District—E. J. Stapleton,
Eastern District—R. J. Smith,
Northern District—T. W. Brackinreid.

The proceedings adjourned at 5.45 p.m. until the next morning.

At 6.30 p.m. on Wednesday evening the delegates met with the Ontario Municipal Electrical Association for the Convention dinner when Mr. Norman Sommerville, K.C., as guest of the evening, gave an address.

The proceedings were called to order at 9.45 a.m. on Thursday, January 20th.

Mr. W. B. Buchanan, Assistant Laboratory Engineer, H.E.P.C. of Ont., read a paper, "Grounding on 4,000 volt Distribution Circuits."

Discussion following Mr. Buchanan's paper was by Messrs. J. S. F. Madden, F. T. Stocking, J. W. Purcell, E. V. Buchanan, R. H. Staford, W. R. Catton, J. E. B. Phelps, C. E. Kirkby, and S. B. Iler.

Mr. H. O. Merriman, Inductive Interference Engineer, Radiotelegraph Branch, Department of Marine and Fisheries, Ottawa, extracted a paper prepared by Mr. C. P. Edwards, Director of Radio Service.

Discussion following this paper was by Messrs. W. R. Catton, E. V. Buchanan, S. B. Iler, Wills Maclachlan, R. J. Smith, C. E. Schwenger and J. R. McLinden.

The proceedings adjourned at 11.45 a.m. to meet again that afternoon.

At 12.30 p.m. the Association met with the Ontario Municipal Electrical Association for luncheon, when Rev. Banks Nelson of Hamilton gave an address.

The third session of the Convention opened at 2.30 p.m., when Mr. H. Shaw, Secretary-Manager, Detroit Electrical Extension Bureau, gave an address and demonstration, "The Inside Story of Residence Wiring." Mr. Shaw then answered a number of questions of the delegates, after which Mr. H. J. McTavish moved, and Mr. J. E. B. Phelps seconded, a motion thanking him for coming to the Convention and Mr. G. J. Mickler for being instrumental in having him come, which was carried.

A playlet, "Merchandising Merchandise," was given by members of the staff of the Windsor Hydro-Electric System.

Mr. E. V. Buchanan gave a short address expressing the appreciation and hearty thanks of the Association to the President and the Executive for the splendid Convention just held, and also to the speakers at the Convention luncheons and dinner and those who had contributed to the programme of the business sessions, which was received with applause. After the President had made reply the Convention adjourned at 4.30 p.m.

The register shows the total number of delegates at the Convention to have been 318, classified as follows:

Class A	117
Class B	56
Commercial	80
Associates	42
Visitors	23

There were 308 in attendance at the first Convention luncheon and 305 at the Convention dinner, while 277 attended the Convention luncheon on the second day.

To the Engineers, Managers, Secretaries and Treasurers of Municipalities Using Hydro Electric Power

Having elected me President of the A.M.E.U. for 1927, I am therefore on the Executive of the O.M.E.A.

I respectfully request all of the above to advise me of any questions they wish me to deal with at any of the O.M.E.A. meetings, because I feel there is a natural desire by the responsible Heads to work out various problems to make the business a success. As your President I will do all in my power to assist you.

Again thanking you for the honor of electing me, and assuring you of my best endeavors, I remain,

Sincerely and Respectfully Yours,
ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES

John J. Heeg,
President.

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in January, 1927.

Appliances

CANADIAN IRONING MACHINE CO., LTD., Woodstock, Ont.

"Super Simplex" electrically-heated Ironing Machine.

* * * *

KANT-COOL ELECTRIC WATER HEATER CO., Ogdensburg, N. Y.

"Kant-Kool" Portable Electric Vaporizer.

* * * *

THE LESLIE ELECTRIC CO., 74 Grange Avenue, Toronto.

Sheet Heaters for Printing Presses.

* * * *

MANTON BROTHERS, 105 Elizabeth Street, Toronto.

Sheet Heater for Printing Presses.

* * * *

THE McCLARY MANUFACTURING CO., London, Ont.

"A & F" Clamp-on type Electric Water Heater.

* * * *

THE NATIONAL ELECTRIC HEATING CO., LIMITED, 544 Queen St. East, Toronto.

Kitchenette Ranges. Cat. Nos. 500, 505 and 510.

* * * *

VULCAN ELECTRIC PRODUCTS, 105 Colbeck St., Toronto.

"Vulcan" Portable Rectifiers.

* * * *

THE FRANK E. WOLCOTT MANUFACTURING CO., Hartford, Conn.

"Torrid" Upright Toaster. Cat. No. 600.

* * * *

*THE MASTER ELECTRIC CO., 421 S. Market St., Chicago, Ill.

Marcelling Iron Heater.

* * * *

Switches

J. H. TUCKER & CO., LTD., King's Road, Tyseley, Birmingham, Eng.

"Tucker" Tumbler type Sunk-Mounting Snap Switches, single-pole. Cat. No. C.2000; with steatite operating lever, Cat. No. C.2004.

Tumbler type Surface Mounting Snap Switches, single-pole with brass cover and operating lever. Cat. No. B.4000; with cover of moulded composition insulating material and steatite operating lever, Cat. No. B.4008.

Marking: Words "Tucker" or "Telac" appear in front of porcelain or are stamped in metal frame.

* * * *

*GAYNOR ELECTRIC CO. INC., Bridgeport, Conn.

Toggle type, single-pole Flush Switches. Cat. No. 502.

* * * *

Portable Lighting Devices

HERBERT & NEUWIRTH & CO. INC., 25 West 23rd Street, New York, N. Y.

Portable Electric Lamps.

Fittings

Ivori-Craft Corporation, 292 Chestnut St., Newark, N. J.

Switch Box Covers, "Ivori-Craft"

* * * *

Hale Brothers, 84 St. Antoine St., Montreal, Que.

"Halebro" Composition Weatherproof Sockets,

Separable Attachment Plug, Cat. No. 500,

Triple Current Tap, Cat. No. 20.

* * * *

Miscellaneous

*The Acme Electric Mfg. Co. 186-188 3rd St., Chelsea, Mass.

Edison Plug Fuses.

Marking: "Crystal".

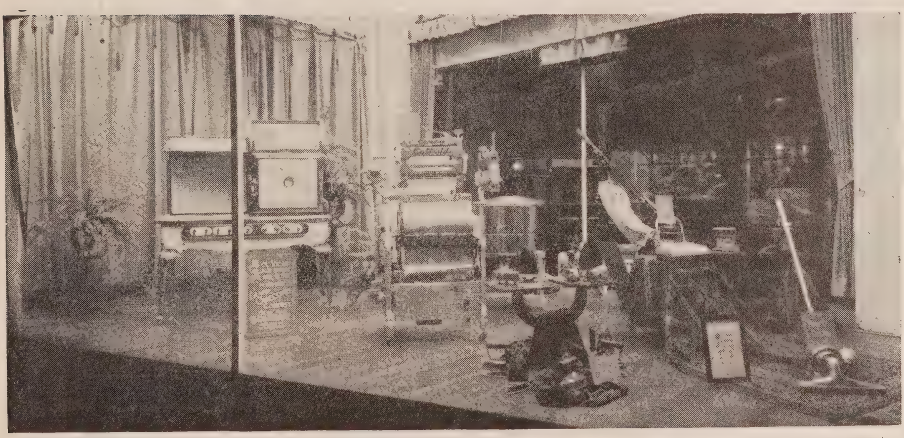
* * * *

*The M. Propp Co., 524-528 Broadway, New York, N. Y.

Heater Cord Sets, Cat. No. 550.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.



Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

Cutting Down Overhead Cost

Users of Hydro power have been enabled to cut down their operating expense, owing to the low rates in force on all Hydro systems.

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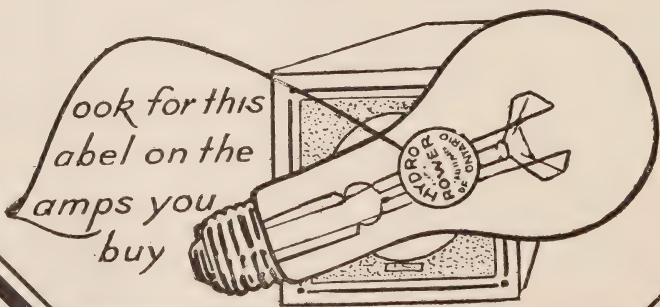

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New 3,000 kw. Synchronous Converter Station at Windsor

THE Hydro-Electric Power Commission of Ontario operating the street railway in the Border Municipalities and the inter-urban lines to Tecumseh and Amherstburg, has just completed a new 3000 kw. manually operated Synchronous Converter Station on McDougall Street, Windsor, this station being supplied with power from the Niagara System of the Commission at 26,400 volts.

When the railways were acquired by the Commission for the Municipalities interested in 1920, the population served was approximately 60,000, and while some small extensions were contemplated at that time, it was not conceived that the system would expand to its present proportions in such a short period of time. The population now served is approximately 105,000 and is still growing.

The power supply at the time of purchase consisted of steam units installed at the Salt Block Distributing Station, the contract for power from this source expiring late in 1928. This power was augmented in 1921 by a 500 kw. Synchronous Converter, a second hand unit being purchased and installed at the Salt Block Station. To meet further increasing power demands in 1924 a 400 kw. sub-station was constructed at Petrimoux. This was augmented in 1925 by 500 kw. temporary stations at Windsor and Ford, the rapidly increasing traffic in these areas taxing the installed plant capacities at that time.

Additional power was required in 1926 to supply the demand created by the purchase of 20 large double truck cars and as provision had to be made for the retirement of the Salt Block Station in 1928 and the

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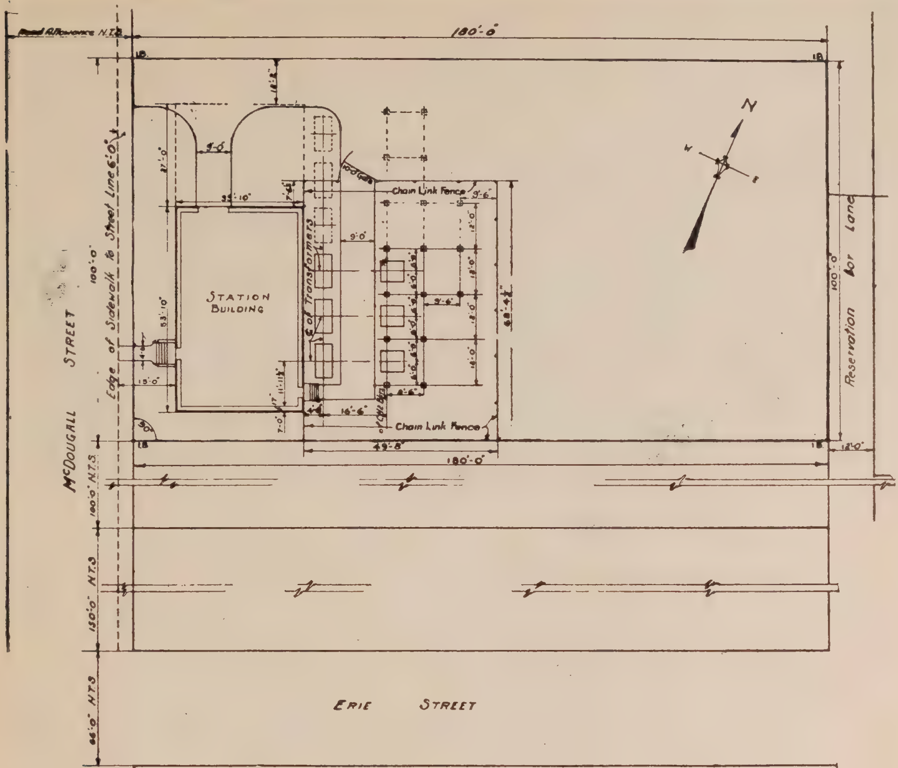
system's annual increase, it was decided to construct a large converter sub station near the centre of Windsor. A study was made of the districts being served, and the location of the sub station was decided on at McDougall Street, Windsor, near Erie Street, this station to be reinforced by stations at Ford and Sandwich when the growth demanded. As mentioned, a temporary station is in service at Ford, but no action has as yet been taken at Sandwich. The Windsor sub station is located approximately one and a quarter miles from the down town section, the purpose of this location being to supply power to the heavily loaded section down town where speed is not required and still maintain a high voltage on the light loaded urban sections where speed is essential. It has also been provided with sufficient capacity to absorb the Salt Block plant capacity, to handle the system increase in demand and with provision for extension at a later date when addi-

Converter Station Building from McDougall Street.



Site Plan of Converter Station.

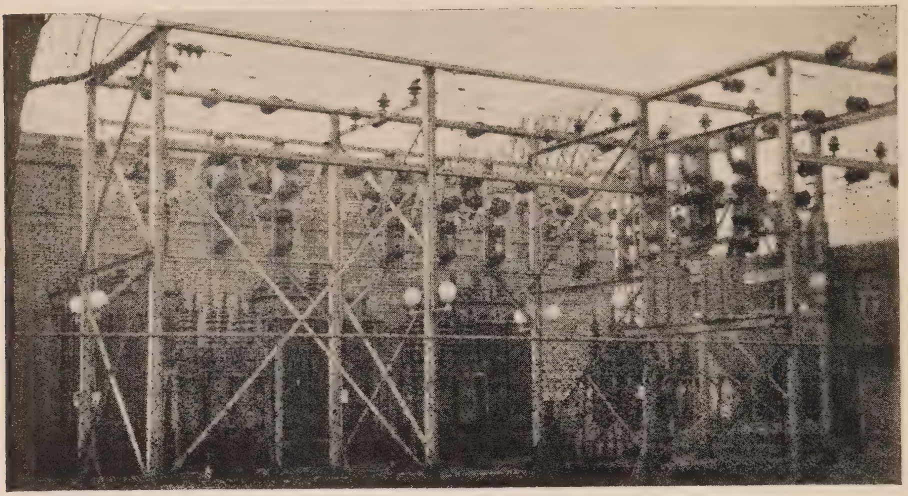
tional railway power is required in the Windsor district.

Energy for railway operation is converted from 26,400 volts, 25 cycles, alternating current, to 600 volts direct current trolley voltage.

The sub station building is of brick construction with concrete foundation and cut stone trim. The interior finish of the walls is of buff brick while the exterior surface of the walls is of red pressed brick. A basement is provided to accommodate the cables as well as providing space to form part of the ventilating scheme for the cooling of the converters. Windows on all sides provide natural lighting, no provision being made for their opening in the machine room during the summer months which condition would destroy the ventilating scheme provided. The building is 32 feet wide, 53 feet long and 21 feet high and is of sufficient size to house four 1,000 kw. converters. Provision has also been made for an extension to the North to house two additional units. A five ton travelling crane for handling the converters spans the machine room.

Ventilating Scheme

One section of the basement is walled off from the general basement in which the direct current positive



26,000 volt Bus and Switching Equipment.

feeders run to the machine switchboard panels and where positive feeder cables enter the underground ducts leading across McDougall street to the feeder pole line. The other section into which entrance is provided through two doors in the dividing wall, houses the negative and equalizer bus work and alternating current leads to the converters. This section forms part of the ventilating system and is provided with windows which open by worm drive from the main floor by means of which the operator can control the amount of cooling air passing through the machine pits for cooling. Four 3 foot Swartwout ventilators are installed in the roof through which the air is passed to the outdoors. As mentioned above, the machine room has no window ventilation, and the air circulation for cooling is drawn from the basement through the machine pits and then by chimney action through the roof ventilators to the outside. A complete circulation of air from the floor of the machine room is provided in this scheme.

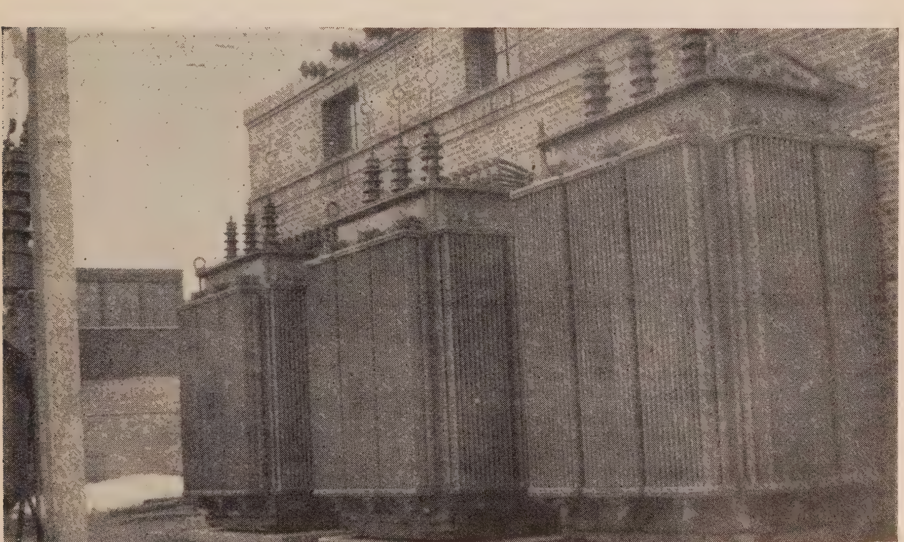
High Voltage Structure and Equipment

The 26,400 volt equipment is all outdoors, the mounting structure being fabricated of steel. The main supply is fed from the 26,400 volt bus in the Windsor Municipal Station over one feeder thereby benefiting by parallel line supply to the Windsor Municipal Station. Each converter unit with transformer has a separate bay in the structure in which individual breakers, current transformers and disconnecting switches are installed. The high voltage breakers are remote controlled and manually operated from the machine room. Trouble in any one unit is accordingly localized and the unit is cleared from the system without interference with the general plant operation.

The transformers are of Canadian Westinghouse Company Manufacture and are rated at 1100 kv-a. These are three phase 25 cycle units and step down the voltage to 440 volts six phase synchronous converter voltage. Taps are provided on the low voltage side for starting the converters, the converters being designed for 110 volt a.c. starting. These transformers are oil insulated self cooled radiator type and are designed for outdoor service. The reactance of these units is 15 percent to obtain proper voltage regulation which characteristic also limits the stresses due to short circuits and flash overs on the converter to conservative values.

The transformers are installed on concrete foundations adjacent to the sub station wall. The secondary leads run through porcelain bushings in the wall to the rings of the converters and to the manually operated starting panel adjacent to each machine. These leads are racked to the inside wall and basement in which location they are run after leaving the starting switches.

The converters are rated at 1,000 kw. and are also fabricated by the Canadian Westinghouse Company. These are of the compound interpole type and operate at 750 rev. per min. They have a continuous rating of 1,000 kw. at 40° cent. rise followed by 150 percent load for two hours with a 55° cent. rise. Following this load the converters are capable of withstanding 300 percent load momentarily. Three units only are now being installed, all being in operation at the time of writing. Provision has been made in the present building for a fourth unit, additional units requiring building extension.



1,100 kv-a, 26,400 volt, 3 phase, to 440 volt, 6 phase 25 cycle, radiator type Transformers.

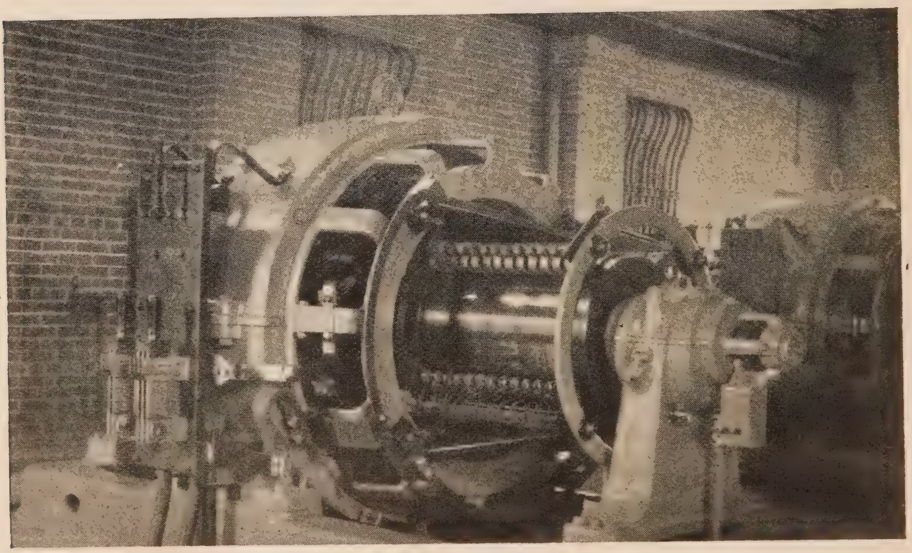
The machines are started by means of a three pole double throw 1200 ampere disconnecting switch fitted with quick break contacts on the starting and running side. This switch is thrown to the up position in starting and down position for normal running.

Each converter has its field switch, a 3,000 ampere negative switch and a 2,000 ampere equalizer switch mounted on a panel on the frame of the machine, the negative and equalizer switch connections being made through the floor to the negative and equalizer buses running the length of the building directly below the machines.

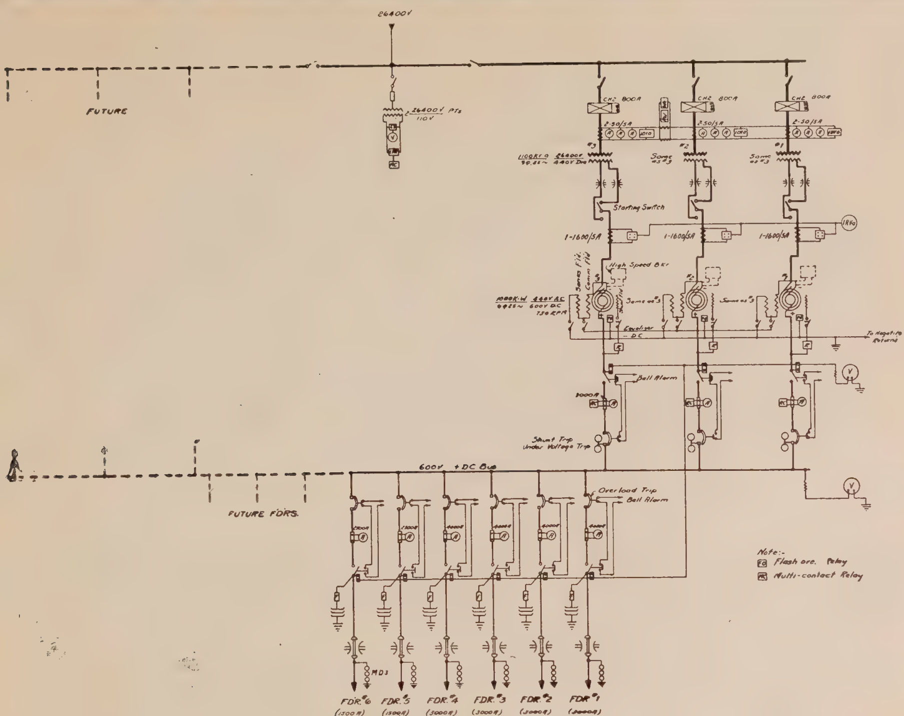
Three machine panels are installed at one end of the direct current switchboard, which at present also comprises six positive feeder panels. Future machines will have their panels installed at the other end of the switchboard with provision for three additional feeder panels to be installed intermediate at that time.

The positive feeders leave the building underground in fibre duct set in concrete, each feeder run to the structure being 1,000,000 cir. mils cambric insulated lead covered cable. These ducts lead across the street and the cable rises in the vertical on a twin pole structure through 20 feet of iron conduit which is provided in lieu of the usual choke coil. Multigap lightning arresters are used outdoors on the structure as a protection for the cable in the duct, while arresters of the Aluminum Cell type are used indoors to obtain adequate equipment protection.

Four of the present feeders are rated at 3,000 amperes and two rated at 1,500 amperes. These feeder



1,000 kw. Synchronous Converters.



Station Wiring Diagram.

panels were supplied by the Canadian General Electric Company.

A liberally designed lighting scheme has been provided, and all lights are supplied from the direct current bus through a specially designed 600 volt lighting cabinet. To assist in the natural lighting scheme, the interior walls are a light buff brick, the ceiling white and the floor and converters have been painted a battle ship gray.

The machine field rheostats are installed in the basement, this leaving the rear of the direct current switchboard in the machine room safe for maintenance work.

Protective Equipment

Each converter equipment is complete with the following protective features, the functioning of which disconnects the unit involved in trouble from the system.

(a) Overspeed device.
(b) Under-voltage on the a.c. supply system.
(c) Flashover relay to protect in case of a machine d.c. flashover.
(d) Failure of the d.c. voltage.
(e) A.C. breakers with overload relays.
(f) D.C. breakers with under voltage and overload attachments.
(g) D.C. power directional relay.

There are no special features in the above other than both the a.c. and d.c. breakers function simultaneously instead of as in common practice where the a.c. breaker is

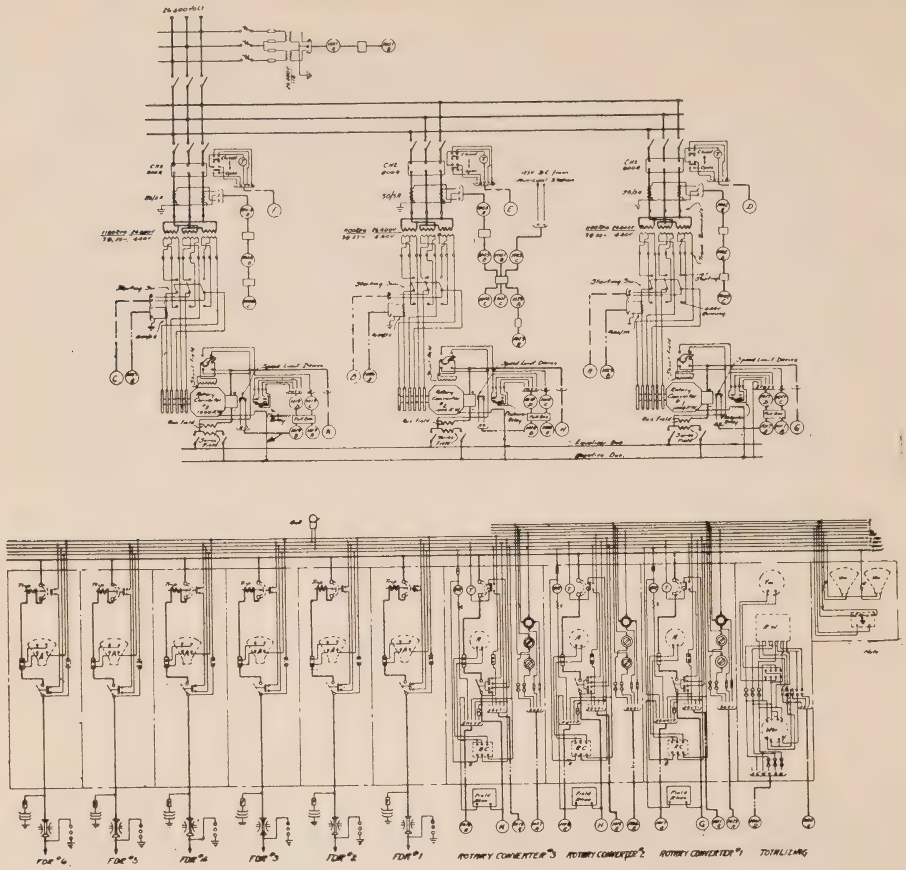


Diagram of Connections.

first opened which in turn by means of a mechanically operated pallet switch trips the d.c. breaker.

The construction work on both building and electrical equipment was carried out by the Commission's Construction staff. Work was commenced in July, 1926, and was completed during February of this year. The first unit was placed in operation on December 1st, 1926, the second unit January 15th, 1927, and the third unit February 18th, 1927.

Production of explosives, ammunition, fireworks and matches in Canada in 1925 amounted in value to $12,313,155, according to the Dominion Bureau of Statistics. Explosives produced during the year were valued at $7,999,856, ammunition at $2,129,975; fireworks totalled $128,684 in value and the output of matches, $2,054,640.—*Natural Resources, Canada.*

Application of Hydro-Electric Power to Farm Work

Article No. 7.

ONE of the many rural users who gave special consideration to the equipping of the home for convenience and comfort was Mr. Fred Startt, whose farm is located in the Woodstock Rural Power District, to which service connection was made in November, 1922. A good lighting installation throughout the property was made, but, as in most cases so far in the country, they have overlooked the necessity for convenience outlets in the house, as illustrated in Fig. 1, which shows the stand lamp connected to the drop fixture in the living-room. The automatic system giving a water service equal to that of a town or city is being used to fullest extent. A well equipped bathroom shown in Fig. 2 on the second floor serves the house proper, a convenience station and wash basin in the basement, shown with the water system in Fig. 3, are for the use of farm workers, thereby placing the washroom away from the living quarters proper. Arrangements adjacent to the sink have been made for hanging working clothes and keeping substitute clothing and shoes handy for use when in the house.

In the barn, besides lighting, a 5 h.p. motor is used for chopping

Fig. 1. In the Living room.

Fig. 3. Bathroom.

grain and pulping roots. Motor, chopper and a section of line shafting are shown in Fig. 4.

The installation on this place consists of—

1,675 watts capacity in lamps
600 " Electric iron
600 " toaster
186 " in the motor on automatic water system
3,730 watts in the 5 h.p. motor

The power consumption for all uses and the net cost for the year ending December 31, 1926, are given below, the cost in the district for Class 4 for this period being:

Service Charge—$4.30 per month.
Consumption Charge—4c. per kw-

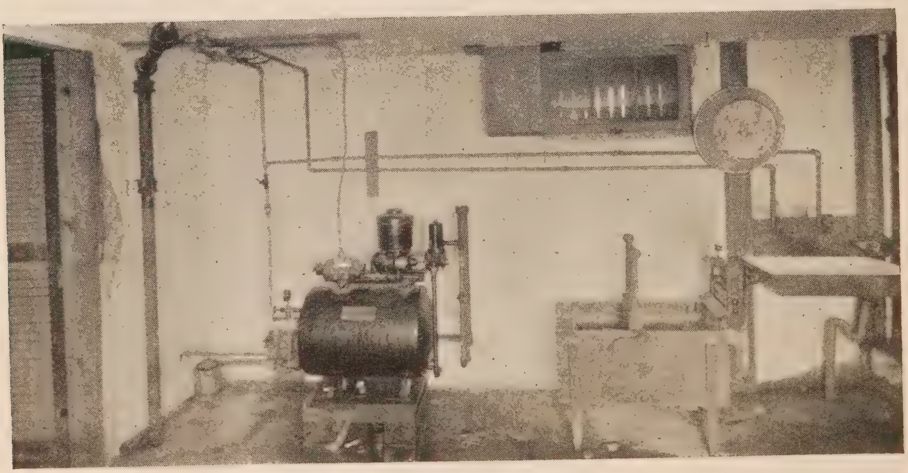


Fig. 3. Water Installation in Basement.

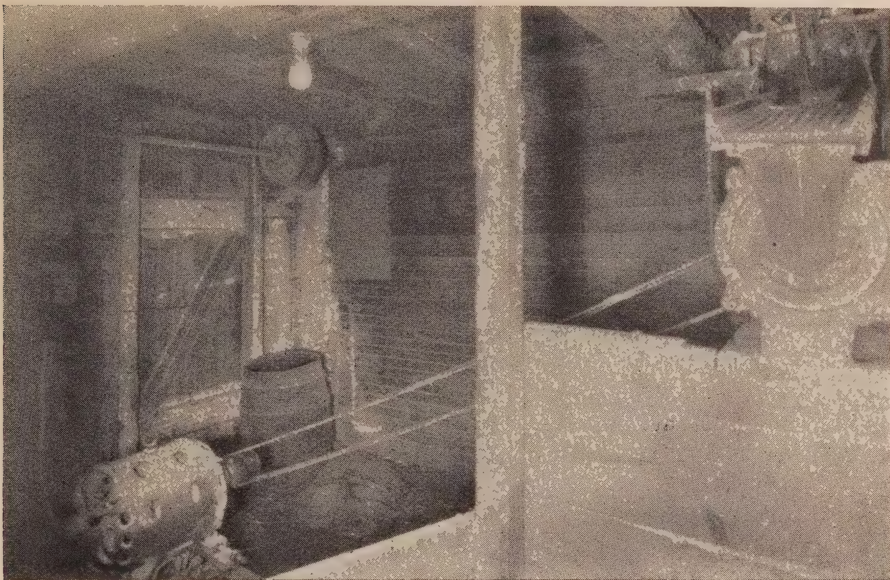


Fig. 4. 5 h.p. Motor belted to Chopper in barn.

hr. for the first 70 kw-hrs. taken in any month.

2c. per kw-hr. for the balance of the power taken.

A 10% discount being allowed for payment within the specified period.

Details of work done on the place during the year are not available.

	Consumption Total	At 2nd Rate	Net Cost
For 3 months ending March 31st......	263	53	$20.12
" 3 " " June 30th........	190		18.45
" 4 " " October 31st......	263		24.95
" 2 " " December 31st....	232	92	14.44
Total..........	948	145	$77.96

Water Power Progress in 1926

THE annual statement of the Honourable Charles Stewart, Minister of the Interior, regarding the development, distribution, and use of hydro-electric energy in Canada confirms his estimate made a year ago that during 1926 more than 250,000 horsepower would be added to the total hydro-electric development of the Dominion. The actual figure is 266,000 horsepower and the total installation now amounts to 4,556,000 horsepower. The new installations represent a direct investment of at least $25,000,000 without regard to new capital required in the application of the power.

New hydro-electric enterprises require several years to progress from the prospect stage to the actual production of power, but from the time of the completion of the initial unit until the full capacity of the site is reached, a station continues to record increases as new units are added. The record installation of 1925 was, in a considerable measure, due to the bringing of existing stations up to capacity and it was therefore inevitable that the new units added during 1926 should reach a more modest total. Nevertheless, 1926 was, even more than 1925, a banner year in hydro-electric enterprise. Projects were actually under way which will ultimately add 1,700,000 horsepower to the total development, while three plants comprising a single enterprise, will have a capacity double that of the entire new installation during 1926. Of these three plants, two are nearly completed. In addition to the projects actually under construction others involving a further 1,000,000 horse-power are in active prospect. A direct investment, therefore, of $270,000,000 at least may be expected in Canada's hydro-electric industry during the next few years, with a further and much larger investment in industries and equipment for the distribution and utilization of this new supply of power.

The water-power industry of the Dominion is a product of the twentieth century and in its early years was sustained by the vision and skill of engineers backed by the foresight and energy of a few financial leaders. New problems had to be met and overcome without the assistance of adequate physical data, or of experience in similar work elsewhere. The problems to be solved involved the whole gamut of science, and present installations embody a wide range of new knowledge concerning construction, hydraulics, mechanics and electricity. The modern installation shows but little similarity in either layout or construction to the pioneer plants but these earlier plants were nevertheless extremely successful and by their success they have made all that has followed possible. Now, the investing public is not only willing but anxious to invest funds in any properly sponsored hydro-electric enterprise and 1926 has shown, by the extraordinary

advances recorded in the quotations for power securities, the high reputation they enjoy.

The confidence thus shown is in no small measure due to the elimination of quesswork as the basis of development. Nearly twenty years ago the Department of the Interior commenced the work of accumulating basic water resources data. Beginning first in the Prairie Provinces and in the Railway Belt of British Columbia the work spread on a co-operative basis to other provinces with the result that there has been for some years a Dominion Hydrometric Survey (carried on by the Dominion Water Power and Reclamation Service, ably seconded by the co-operating provincial authorities), engaged in the systematic and uniform accumulation of basic water resources data throughout Canada. In consequence the all-important question of water supply is no longer one of uncertainty.

The extraordinary value of Canadian water-power lies in its low cost which is such that it enables industry to utilize it to the full. The pulp and paper industry relies almost entirely upon water-power as, excluding coal mining, does the mining industry. The value of the production of these two industries alone is enormous and if to this be added the value of the output of the numerous manufactories utilizing this source of power and of the municipal and domestic services rendered, it becomes evident that water-power is one of the principal foundations of our national prosperity.

The outstanding activities during 1926 occurred in the province of Quebec, although some of the greatest of these are not reflected in the total of new installations as they did not reach the production stage. In British Columbia and Manitoba noteworthy advances were recorded while in the remaining provinces progress was made on a number of promising projects.

In Quebec 168,000 horsepower was installed, 90,000 of which was in the Ile Maligne station of the Duke-Price Company on the Saguenay river. This increases the installation there from 360,000 to 450,000 horsepower, the ultimate capacity being 540,000 horsepower. Of the remaining installations two may be mentioned: the replacement of a 1,600 horsepower development by one of 22,200 horsepower on the Batiscan river by the Shawinigan interests and a 16,800 horsepower addition at the Kipawa plant of the Canadian International Paper Company. The latter company is also responsible, through its subsidiary the Gatineau Power Company, for the greatest hydro-electric construction work during the year. Two plants on the Gatineau river, one at Chelsea of 170,000 horsepower and one at Farmer's rapids of 120,000 horsepower were nearly completed by this company, while a third at Paugan Falls of 240,000 horsepower was begun. Progress was also made on another and larger development, that of the Aluminum Company of Canada at Chute-a-Caron on the Saguenay river where a development of 800,000 horsepower ultimate capacity is in course of construction. This company is already operating its reduction works at

the new town of Arvida with power from Ile Maligne. The Ontario Paper Company commenced the construction of a 40,000 horsepower station on the Outardes river.

The Quebec Streams Commission continued its valuable work in connection with construction and operation of storage reservoirs in the interest of power development, and is at present directing the construction of the Baskatong reservoir on the Gatineau river which is being carried on by the Canadian International Paper Company.

There was a lull in hydro-electric development in Ontario due to the completion in 1925 of a heavy construction programme, the principal units of which were the Queenston-Chippawa plant at Niagara and the Cameron Falls plant on the Nipigon river. These two stations of the Ontario Hydro-Electric Power Commission with 550,000 horsepower and 75,000 horsepower capacities respectively were completed in 1925. Before undertaking a further heavy programme the Commission has availed itself of a block of about a quarter of a million horsepower from the Gatineau plants above referred to and has contracted for this power, delivery to commence in 1928. The Commission has other large enterprises in view which, together with the developments already commenced of the Spruce Falls Company at Smoky Falls on the Mattagami river and of the Backus-Brooks Company on the Seine river, of 70,000 horsepower and 37,620 horsepower respectively, will maintain Ontario in its high place amongst the water-power provinces of the Dominion.

New development in British Columbia was but little behind that of last year and amounted to 45,860 horsepower. Of this 25,860 horsepower was contributed by the Powell River Company and 20,000 horsepower by the West Kootenay Light and Power Company, which, by the addition of its third unit, completed its 60,000 horsepower plant at Lower Bonnington Falls on the Kootenay river. This company is carrying on preliminary work in connection with a new 60,000 horsepower development at South Slocan. The British Columbia Electric Railway Company completed its storage dam at the outlet of Alouette lake and proceeded with the construction of the 12,500 horsepower Alouette power station. The same company also continued with its Bridge River project, the initial capacity of which will be 54,000 horsepower and the scheme as a whole is expected to have an ultimate capacity of from 550,000 to 700,000 horsepower.

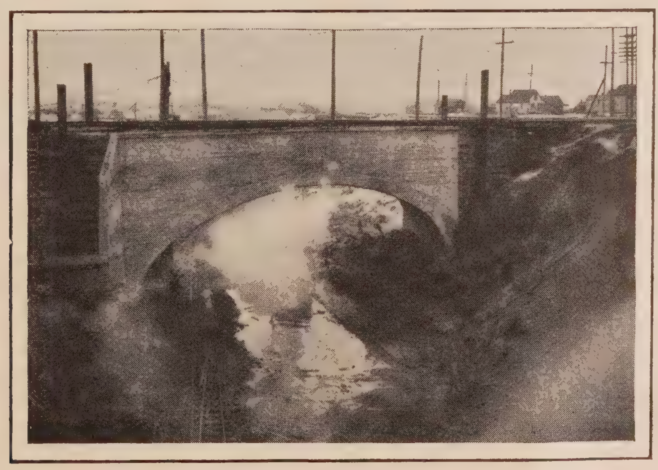
In Manitoba, additions to the existing plants of the city of Winnipeg and the Manitoba Power Company amounted to 43,200 horsepower, 15,200 horsepower of which was represented by the addition of units 15 and 16 to the city's station at Point du Bois on the Winnipeg River. This plant is now completely installed and has a capacity of 109,000 horsepower. At Great Falls on the same river the Manitoba Power Company installed unit No. 3 of 28,000 horsepower capacity and let the contract for a similar unit to be installed during 1927. In addition

the company completed the work necessary to permit the forebay level to be raised so as to provide the full designed head, and built a steel-tower transmission line from the plant to the mill of the Manitoba Paper Company at Fort Alexander.

In New Brunswick 2,600 horsepower of new installation was due to the replacement of a unit in the plant on the Aroostook river of the Maine and New Brunswick Electrical Power Company. The chief activity, however, was the initiation of work at Grand Falls on the St. John river where construction of an initial installation of 60,000 horsepower was begun by the St. John River Power Company. The New Brunswick Electric Power Commission carried out further work in connection with its Musquash system and is investigating the Meductic Falls site on the St. John river about 40 miles from Fredericton. The Bathurst Company has investigated the Nipisiguit river; it is thought that some 40,000 horsepower will be developed for use in the company's pulp and paper mills.

In Nova Scotia a 300 horsepower unit was added to the Nova Scotia Power Commission's Mushamush development. This Commission is building two new storage dams on East River Sheet harbour, is extending its transmission system, and has in prospect further developments for the St. Margaret's Bay system and on the Medway river. Among other active projects in Nova Scotia is a 330 horsepower plant now under construction at the upper falls of the Sissiboo river for the supply of Weymouth, Digby, and Smith's Cove, and projected developments at Avon River Falls and on the Tusket river, the last named being intended for the supplying of power to Yarmouth.

While the new installations in 1926 fell considerably short of 1925, the work initiated greatly exceeded the record of that year, and for this reason very substantial installations may be looked for not only during 1927, but in succeeding years.—*Natural Resources, Canada.*



Lightning

By F. W. Peek Jr., General Electric Company, Schenectady, N.Y.

(Address before Association of Municipal Electrical Utilities at Toronto, January 19th, 1927.)

THE object of the study which I am about to describe has been to establish rules for determining the voltages of lightning on transmission lines; the lightning arc-over voltage of insulators and the lightning strength of apparatus; the value of the ground wire, etc. With such information it is possible to estimate the reliability of transmission.

Lightning

A lightning stroke is the electrical breakdown of a large natural condenser. The plates of this condenser may be two clouds but of especial interest is the condenser consisting of cloud and earth with the intervening air as the insulation.

During a thunder storm this condenser is gradually charged by the action of air on rain-drops. It is known, for instance, that when water drops are torn apart by air currents the water becomes positively charged and the air negatively charged. An electric generator is thus provided. Without going into details, the upward air currents, which always occur during an electric storm, carry the charges to the clouds. The voltage between cloud and earth becomes higher and higher with increasing charge. If it becomes high enough for the space between cloud and earth, or the volts per foot or stress becomes high enough, breakdown occurs and the condenser becomes short circuited. The electrical energy is dissipated through a transient into heat, light and sound and chemical energy.

Before breakdown the air under the cloud is under electrical stress. This stress is greatest under the storm center. An electrical field could thus be plotted which would show lines of force similar to the lines of force of a magnet. It is of interest that during a storm we walk around in the insulation of this cloud condenser without any effects.

Lightning Research

The most practicable method of conducting lightning research is to combine a study in the field of natural lightning with study in the laboratory with artificial. Such a study has been underway for a number of years. The general method of attack was to make observations in the field and then go to the laboratory and try to reproduce the effects on models.

Artificial Lightning and the Two Million Volt Lightning Generator

The artificial lightning was produced by a two million volt lightning generator. This generator, as in

the case of the natural generator, consists of a large condenser. This condenser is more compact than the natural condensers because the insulation is made of glass instead of air. It is charged slowly and discharged at a very rapid rate. The power is of the order of a million kilowatts, the current ten thousand amperes, and the time of discharge a few microseconds (millionths of seconds). The rate of discharge is so great that the spark is best described as electric dynamite. This description also applies to natural lightning.

The discharge occurs with a loud sharp report. Wood is split and blown violently apart; a discharge in water causes it to be punctured explosively just as oil is punctured; a wire is evaporated; fulgurites are formed, etc.

Voltage and Energy of Lightning

The lightning generator has been an almost direct means of measuring the voltage of natural lightning. This was done in the following manner: When a lightning flash occurs in the vicinity of a transmission line a certain percentage of that voltage appears on the line. The voltage of the flash cannot be measured directly but the percentage of the voltage induced in the line can be measured. Thus, if the percentage is known, the voltage of lightning can be determined from the voltage induced upon the line. In the mountains of Colorado in a certain case one million volts were observed upon a line. The height, size and distance to the cloud was observed. A model was made in the laboratory and it was found that the model cloud caused 1 percent of its voltage to appear upon the line. The voltage on the actual cloud then must have been of the order of one hundred million volts. From such a study the general order of magnitudes of the characteristics of lightning are as follows:—

Voltage.....100,000,000.
Current.....100,000 amperes.
Energy.....4 kw-hrs.
Power.....Thousand billion horse power.
Time.....A few microseconds.
Gradient at breakdown 100 kv-ft.

This incidentally checks with the extension of the needle gap curve from 2,000 volts.

The discharge is generally non-oscillatory.

An interesting thing about these figures is the wide range of the quantities involved—from one millionth to a thousand billion.

It might be of interest here to speculate for a moment on the power necessary to supply the world with lightning. It has been estimated that there are 300,000 lightning strokes per every hour of the day. If the energy dissipated is 4 kw-hrs. per stroke, the total energy is 1,200,000 kw-hrs. per hour. This means a plant of a capacity of 1,200,000 kw. operating continuously—about the present developed Niagara.

Voltages by Induction and Direct Strokes

A direct stroke is very severe and generally destructive but it is not necessary for lightning to actually strike an object to cause damage.

High voltages may be caused by induction on conductors as far as a mile away. These induced voltages may cause sparks.

Induced Voltages

A short discussion as to how a conductor receives voltage by induction may be of interest. Everywhere under a charged cloud the space has a certain potential. If a short, well insulated conductor is placed on an equipotential surface it takes the potential of the space in which it is located. Assume the cloud negatively charged. The conductor takes a positive charge on the side nearest the cloud and a negative charge on the side farthest from the cloud. The charge on the ground is positive. When the cloud discharges, the two charges on the wire go together and the potential of the wire becomes zero.

In this case it is possible for a spark to occur from the insulated wire and some other wire near it but differently located in space, even though the cloud does not discharge. What is usually known as static induction, however, occurs as follows: Assume the wire to be poorly insulated or grounded; the negative charge leaks away. The wire becomes positively charged and is at zero potential. When the cloud discharges, the bound charge on the wire is released which causes it to take a potential above ground with a sign opposite to that of the cloud. The wire generally reaches its maximum potential at the instant that the cloud reaches zero. The potential that the wire assumes is approximately equal to its height above ground times the voltage gradient or volts per foot, measured vertically. The voltage gradient depends upon the position of the cloud with reference to the wire. The maximum voltage that a wire can assume is equal to 100,000 times the height in feet above ground. This is practically a direct stroke. In general this voltage is,

$$V = g \alpha h = G h$$

Where g is the gradient in volts per foot and h is the height in feet. g depends upon the distance of the cloud from the wire. For short wires α is unity. In the case of long transmission lines, α is less than unity, its exact value depending upon the rate at which the cloud discharges and the size of the cloud. This follows because in slowly discharging clouds the charge would be dispersed over the line for a considerable distance before the cloud became completely discharged. Values of $g\alpha$ or apparent gradients, G, as high as 50,000 volts-ft. have been measured on transmission lines. Sparks may also occur on other insulated conductors, on tanks, etc., due to these induced voltages. Grounded wires near and parallel to the line wire reduce induced voltages. A cage around the wires still further reduces them, while a complete metal cover eliminates them. Ground wires on transmission lines may be considered effective if they cut the voltages in half; this would not be the case of conductors in oil tanks because even 500 volts would cause a tiny spark.

Direct Strokes

Researches in the laboratory show that lightning from a cloud over-

head does not always strike the highest object or rod unless it is 2.5 percent of the cloud height. The division of hits is about equal between cloud and ground when the rod is 1.1 percent of cloud height. The chance of being hit is less when the cloud is not directly overhead. Lightning either strikes the rod or some distance away. There is a protected area around the rod with a radius equal to about four times the height of the rod over a wide range of conditions where no ground hits occur. This has been studied by placing the rod or rods on a paper target and recording the hits by the marks on the paper. There is one important factor that affects the protective ratio; that is, cloud height compared to rod height. When the cloud is high compared to the rod the protective ratio may be four or more. As the cloud height is decreased the protective ratio becomes less. Its minimum value is unity when the rod and the cloud are the same height. The value of four is generally reached when the cloud is about ten times the height of the rod.

Explanation of Some Peculiar Effects

When two conducting rods are placed directly under the cloud the higher one protects the lower one. If the higher rod is drawn away from the lower one and the projection of the storm center, the lower one is protected until a critical distance is reached. When hits are divided between the rod. When the separation is increased the hits go to the lower rods.

The following experiment seems to explain some peculiar effects noted in practice. If a high wooden rod and a shorter metal rod are placed close together under a storm center the metal rod is always struck. The wooden rod has no effect. If the wooden rod is now dampened so that it becomes a conductor of high resistance it is struck in preference to the metal rod. However, there is an immediate side flash from the wood to the shorter metal rod. When the wood is made decidedly conducting, it acts like a metal rod and the discharge follows down its surface. The explanation is quite simple:—The high resistance wood was conducting enough to carry the small charging current and thus determine the direction of the stroke. As soon as it was hit, however, its resistance was too high to carry the lightning current; it thus side flashed to the rod. This explains why it is dangerous to stand under a tree; why chimneys are struck with disastrous side flashes; why wooden flag poles are struck and splintered. It also shows why a lightning rod up to the chimney top does not increase the hazard of being struck and in case of a direct hit carries the current and prevents destruction.

Other peculiar occurrences are explained:—

Assume a tall dry wooden church and a clump of trees lower than the church. A tree is struck. About half way down the tree is very badly shattered and blown apart. An examination shows that the lightning flash missed the high church and appears to have struck underneath the branches of the tree. A simple

explanation is as follows: The church was too dry to influence the field. The tree was conducting enough to determine the path of the discharge and the top sappy branches were able to conduct it. The trunk of the tree was too dry to carry the current and caused the tree to split. Such results were shown on a model.

Transmission Lines

Dangerous voltages on transmission lines may be caused by induction or by direct strokes. The voltages by direct strokes are the most severe but the induced voltages are the most numerous. The mechanism of the direct stroke was shown above. Just previous to the discharge the space is everywhere under stress. Directly under the cloud the maximum stress is 100,000 volts per ft.; a quarter mile from the storm center it is 32,000 volts per foot; a half mile it is 12,000 and at a mile it is 3,000.

The line is at zero or operating potential until the discharge or flash begins. The voltage on the line rises and reaches its maximum value at the instant that the cloud reaches zero. This generally requires a few microseconds. The discharge is usually non-oscillatory. As the cloud discharges a wave travels in both directions over the line. The voltage becomes less because of losses and because half of the energy becomes electromagnetic. The maximum voltage that a line can reach is the apparent gradient times the height of the line in feet. An example may be of interest.

Assume that the conductors are in a horizontal plane and 30 feet high. The highest voltage that could occur near the flash would be 30 x 100,000 = 3,000,000 volts; at a quarter of a mile from the flash it would be 960,000 volts; at a half mile 360,000 volts; and at a mile 90,000 volts. Of course the maximum voltage can not be higher than the insulator flash-over; the real limit to the voltage that comes to the stations is the lightning flash-over voltage of the insulator. If a ground wire were used the above values would be reduced to half.

It has been found that apparent gradients as high as 50,000 volts per foot can be expected in practice. The reason that high lightning voltages are not more frequent on lines is because many clouds discharge at a relatively slow rate and because most discharges occur at some distance from the line. The following comparison of a line with conductors in a horizontal plane and conductors in a vertical plane is of interest.

Vertical Arrangement Cond. Hgt. Ft.	Horizontal Cond. Hgt. Ft.	Kilovolts G = 50 No Ground Wire	Kilovolts G = 50 One Ground Wire at top	Kilovolts Between Conductors No Gr. Wire
30		1500	1200	500
40		2000	1200	500
50		2500	1250	500
	30	1500	750	0

If a 14 unit insulator string with a lightning flash-over voltage of 1,800 kv. were used, flash-over would occur or for $G=50$ on the top and middle wires for the vertical arrangement without a ground wire but would not occur on the horizontal arrangement. With a ground wire, flash-over would not occur. Thus in practice, more flash-overs should be expected for the upper conductor in vertical arrangements without a ground wire; with a ground wire the flash-overs should be equal on all conductors. This is exactly what does occur. The above discussion shows the value of the ground wire and the danger of high conductors. It also shows that there will be no voltage between lines for a horizontal arrangement and considerable voltage for a vertical arrangement.

Study in the Field

During the past year measurements have been made of the lightning voltage on transmission lines. These measurements give voltages as calculated by the methods given above; they check the lightning flash-over voltage of the insulators (1,800 kv. for a 14 unit string) and show that the discharge is generally non-oscillatory or highly damped. It is also interesting that so far the induced voltages are positive while the direct hits are negative.

Insulation

The breakdown voltage of insulation, fortunately, is generally higher for lightning voltages than for 60 cycle voltages. For instance, the lightning flash-over voltage of a 14 unit insulator string is 1,800 kv. for a very steep wave front while for a moderate wave front it is 1,200 kv. The 60 cycle flash-over is 1,050 kv. This is due to time lag or to the fact that it takes time for insulation to break down. Thus, with a rapidly rising voltage, breakdown does not take place immediately but permits the voltage to rise above the point where breakdown starts. There is a tendency to add more and more line insulation. In doing this, care must be taken that the insulator arc-over near the station does not exceed the lightning strength of the apparatus unless protective gaps of arresters are used.

Oil Tanks

The principles already discussed can be applied to the protection of buildings, oil tanks, magazine, etc.

Oil is frequently stored in very large quantities. This storage is often so large, in fact, that metal tanks are not economically feasible. The tanks or reservoirs, which are usually made of re-inforced concrete are frequently 500 feet in diameter but sometimes in oval form as large as 600 by 1,200 feet and 30 feet deep. Occasionally some of the smaller tanks are of metal. The capacity ranges from seven hundred thousand to three million barrels. A group of tanks makes up a farm.

The tops of the tanks are covered with wood or wood covered with felt or other materials to keep out the sun and to prevent evaporation. Between the roof and the surface of the oil there is an air space which may contain a mixture of oil vapors. The mixture of air and oil gases may be in the right proportions to be

explosive and ignited by a very small spark. Sparks can occur between metal parts on the roof or between wet parts by induction or by direct strokes and cause fires or explosions. It is probable that induced voltages can cause fires only when inflammable or explosive gases are present. Direct strokes can set oil or wood on fire.

Various principles found in the general study of lightning, as well as specific investigations for transmission lines, etc., can be applied to oil tank and reservoir protection. Additional work done specifically on model oil tanks will be given in greater detail. While work on models and theoretical work cannot always exactly simulate or anticipate all practical conditions, it should be of great help in solving the problems of protection.

Practical Protection

From the investigation it seems that a metal tank offers the only complete protection in oil storage against both direct strokes and induced lightning voltages. The thickness of the metal is not important from the standpoint of induction but from the standpoint of direct strokes must be great enough to prevent melting through. The cover and all other metal parts must be in good electrical contact. This especially applies to parts near together.

When explosive or inflammable gases can be eliminated the problem is greatly simplified since it is reduced to the protection of the tank against direct hits. It appears that this can be done by placing pointed rods around the tank. A round tank can be protected by three rods. No part of the protected area must be a greater distance from some rod than the protective ratio times the height of the rod. This ratio is usually between three and four depending upon the rod height compared to the cloud height. It is desirable to locate the rods about a rod length away from the tank although it is possible that this distance may be as small as half a rod length without trouble. The object of placing the rods in this way is to cause the hits to occur at some distance from the tank and to prevent side flashes. The rods should be grounded to damp earth immediately below. Where the ground resistance is high or uncertain it is probably best to connect the rod to the tank ground as well as to its own ground. If guys are used it is desirable to make them as short as practicable and to attach them to the rod as near the ground as practicable. When there are projections above ground the height of the rods are increased an amount equal to the height of the highest projection.

When inflammable gases are present it is important to reduce or eliminate induced voltages. This can be done by means of a thin metal or conducting roof grounded and preferably extending over the sides. A less degree of protection can be obtained by nets or wires placed on the roof in the same way. When nets are used the smaller the mesh the greater the protection. Less protection would be given by

wires or nets in practice than indicated by tests on models. This follows because the inductance of long wires would not permit them to go instantly to zero potential.

The high degree of protection given by an all metal tank is probably most nearly approached by a combination of rods to take direct hits and a thin metal or conducting roof and sides to protect against induced voltages. Wires or mesh on or above the roof instead of metal sheets would reduce induced voltages to a less extent. Other methods of protection can be worked out from the test data given below. The above methods were discussed in detail as an example because they seemed among the most practicable.

For more detailed information of this work see:

F. W. Peek, Jr.—High voltage Phenomena, Journal Franklin Institute, January, 1924.

F. W. Peek, Jr.—Lightning. Journal Franklin Institute, February, 1925.

F. W. Peek, Jr.—Lightning and other Transients on Transmission Lines. Transactions—A. I. E. E., 1924, Vol. 43, Page 1205.

F. W. Peek, Jr.—Lightning (A study of Lightning Rods and Cables with special reference to the Protection of Oil Tanks). Proceedings American Institute of Electrical Engineers, 1926.

In the porportion of the total power demand met by water-power Canada occupies a unique position. The Census of Central Electric Power Stations shows that 95 per cent. of the total installation is in hydraulic plant and that this furnishes over 98 per cent. of the total output.—*Natural Resources, Canada.*

Faults on Distribution Systems Located by Radio

By C. P. Edwards, Director of Radio Service. Radiotelegraph Branch. Department of Marine and Fisheries, Ottawa.

(Read by H. O. Merriman, Inductive Interference Engineer, before Association of Municipal Electrical Utilities at Toronto, January 20, 1927).

RADIO receivers in general use to-day are among the most sensitive instruments used by scientists.

Due to the fact that they can be used to detect faults on power lines and distribution systems, special portable receivers are now being used extensively as part of the fault finding equipment of public utilities.

In order to clearly understand how a radio receiver may be used to detect faults, let us first consider how these faults actually affect the radio receiver.

For sometime, an instrument has been in use for fault finding, which depends, for its operation, on the magnetic field surrounding the conductor. This magnetic field varies according to the current in the conductor, and, thus, an indication of the changing current in the conductor may be obtained by placing an exploring coil, within this magnetic field, connected to telephones. This magnetic field does not extend to any considerable distance from the conductor carrying the current. These magnetic detectors are very useful in detecting faults in which there is a considerable flow of current, but it is not within the scope of this paper to discuss such a detector.

In contrast to this magnetic detector, the radio receiver may be considered as an instrument for detecting electric radiation. Electric radiation is dependent upon the rate of change of voltage rather than the change of current in the conductor. The rate of change of voltage may also be expressed as the steepness of the wave front of the voltage surge. There is very little electric radiation of this character from power lines on which the voltage varies according to the sine wave, even on power systems using one hundred and ten thousand volts, as the wave front with these voltages at frequencies used for power purposes, such as twenty-five or sixty cycles, is not sufficiently steep to cause radiation. A surge of moderate voltage and extremely small current may, however, cause a very loud response in a radio receiver situated a considerable distance from such a power wire, if the wave front of such a surge is sufficiently steep. It is on this account that the radio receiver is so useful in locating faults. When the radio receiver is placed a few yards from the power wire, it will not indicate as long as the wave form of the voltage on the conductor remains normal, but

will give a decided response whenever a surge of steep wave front occurs on the line. These surges are practically always associated with something abnormal, usually in the nature of a spark, and, very often, indicate a fault which, if not located and repaired in its early stages, may develop to such an extent as to cause depreciation or damage to the line or apparatus.

There are many faults on distribution systems, such as contact from a power wire to some ungrounded metal, which may be located more readily by means of a radio receiver than by any other method at present in use. Faults of this nature cause, very often, considerable hazard to both the linemen and the general public, and there have been, recently, a number of serious accidents due to persons coming in contact with some ungrounded metal, such as cross arm braces, transformer cases and guy-wires, which had accidentally come in contact with live wires.

Types of Radio Receivers Used for Locating Faults on Distribution Systems

Any type of portable receiver, which is sufficiently sensitive, connected with a loop type of antennae may be used for this purpose. The following features, however, should be considered in choosing a receiver.

(1) *Sensitivity and Portability*

Sensitivity is a decided advantage for the work, provided that the sensitivity may be reduced when required, by what is known as volume control. Six or eight tube superheterodynes are used by a number of public utilities for this purpose, but a large receiver such as this, complete with batteries, is too heavy to carry during investigations and requires an automobile for purposes of transportation.

A two or three-tube regenerative receiver is sufficiently sensitive for locating faults on distribution systems and has the advantage of being light enough for one man to carry the complete set, including batteries and accessories.

(2) *Volume Control*

The volume control referred to above is useful for two or three reasons. In the first place a very sensitive set will pick up such a variety of noises that it is difficult to find the fault causing one particular noise under investigation. For instance, when a superheterodyne, at its most sensitive setting, is placed near a street car line the noise in the receiver, due to radiation from the trolley line, is so great as to make it difficult to distinguish a noise caused by a fault on the distribution system. If, however, the volume control is adjusted so as to reduce the sensitivity and volume of noise in the receiver, the particular sound under consideration may be more readily identified.

Another reason for reducing the volume is due to the fact that the ear is more sensitive to sound of moderate strength than to either very loud or very faint sounds. In other words, if the sound in the radio receiver is too great it is apt to be deafening. The third use of the volume control is that of an audibility meter, which is an instrument for indicating the loudness of sound.

For this purpose the audibility meter is adjusted, so that the sound in the telephones under consideration is just audible and the setting of the audibility meter recorded, thus giving an indication of the loudness of the sound. During an investigation it is very often convenient to record the loudness of the sound at different locations, as a record of this kind may be used in tracing the fault on the line producing this sound in the receiver.

(3) *Non-Microphonic*

The set for this purpose should be non-microphonic, or, in other words, there should be no noise in the receivers due to the mechanical vibration of the set. This is a very important consideration, as the set is to be used while being carried about and any sound in the receivers due to the mechanical vibration would interfere with the observations.

(4) *Directional Properties and Shielding*

A great deal has been written regarding the importance of a thoroughly shielded set for this purpose in order to improve the directional properties, but it has been our experience that the shielding is of very little value for a set used outside the power house for finding faults on lines. It is considered, therefore, for the two or three-tube portable set, in particular, that the advantages of shielding do not compensate for the extra weight and possible loss of sensitivity due to same. When the volume control of the set is adjusted so that the sound in the receiver is of moderate strength, the directional properties of an unshielded set are sufficiently good, as the signal picked up by the loop antennae is very much greater than that picked up by the remainder of the set.

For investigations in the power house, however, there is a decided advantage in having a thoroughly shielded set, as both the magnetic and electrostatic fields within the power house are all usually sufficiently strong to produce, in an unshielded set, loud noises in the receivers, entirely independent of the position of the antennae.

(5) *Rugged Construction*

The set for this purpose should be very strongly built in every detail so that no wire or part may be shaken loose due to continual handling. With some types of receivers it is an advantage to mount the tubes on some type of shock absorber, such as sponge rubber.

Details of Special Receivers in Use

The Radio Branch of the Department of Marine and Fisheries use two type of receivers in their work of investigation along this line.

(1) *The Superheterodyne*

A six or seven-tube superheterodyne receiver, mounted in a special portable cabinet, which is connected by means of a multi-wire cable plug and jack to a second cabinet containing the batteries and accessories, is used where an automobile is available for patrolling the line. This receiver is sufficiently sensitive to record a noise due to a fault on a distribution system many miles away. In fact, it was used in Hawkes-

bury, recently, to locate a fault on a power line fifteen miles away, and, in Milton, to locate a fault on the distribution system four miles away. It may also be used while the automobile is travelling at a moderate rate of speed, provided that the interference from the car generator is not too great. The interference from the ignition system produces, usually, a sound in the radio receiver which is characteristically different from that produced by the power line, so that this type of interference, if not too great, is not so objectionable. The interference from the ignition system may be recognized by a sharp click due to each spark. Where undue interference is experienced from the car ignition system, it may be reduced by bridging the low tension side of this circuit with a 1 mfd. condenser, connection being made at the rear of the car instrument board or some other convenient point.

(2) *A Three-Tube Portable Receiver*

The part-time investigators of the Radio Branch, Department of Marine and Fisheries, use a three-tube portable receiver for investigation work and where it is inconvenient to take an automobile for patrolling the lines. This is a three-tube regenerative receiver having a detector and two stages of audio amplification. There are two telephone jacks in order that the telephone may be plugged in on the first or second stage of amplification. These jacks, as well as the control of the regeneration, are used as a means of volume control.

Jack "A" is used to disconnect the radio frequency circuit and detector tube, and connect an audio frequency exploring coil to the input of the amplifier. This audio frequency exploring coil and amplifier are used similarly to the magnetic detector used frequently by distribution companies for locating faults.

The batteries for this set are carried in the same cabinet. The collapsible loop, when folded, is carried along with the head-phones in the lid of the cabinet, so that the set, complete with all accessories, may be carried in the one cabinet. The loop is provided with a low capacity lead to connect it to the receiver. This lead has the two conductors spaced an inch apart and it is found that by so reducing the capacity of the lead the sensitivity of the set is very much greater than would be the case if a twisted pair lead were used.

Procedure for Locating Faults on Overhead Lines by Means of a Portable Receiver

The limits of the district in which the radiation from the lines can be detected on the portable receiver should first be determined. A note should be made, also, of the points of greatest intensity of radiation, which may be detected by the volume control or audibility meter. In making this preliminary survey, the investigation should be carried beyond the points of minimum radiation, as, due to some peculiarity in the lines, there may be very little radiation from a certain section of the line, but at each side of this section the radiation may be very much greater.

The directional properties of the radio receiving loop may then be used. This loop will indicate either the direction of the fault or the direction of the wire conducting the surge. The indication in the radio receiver is very much greater when the loop and the power wire, which is carrying the surge are in the same plane than when the loop is perpendicular with that wire. A more accurate determination of this direction is obtained by working on the minimum rather than the maximum signal. In this case the minimum signal is heard when the loop is at right angles to the conductor carrying the surge. For this purpose it is convenient to test at a location where one system of lines crosses another system at right angles, such as at a street intersection. By standing below the point where these conductors cross and swinging the loop in the two directions it is possible to determine in which direction the lines radiating the greatest amount of radio interference are running. In making this test, however, it is necessary to take into consideration the distance of the loop from the power wires.

None of these tests give conclusive results regarding the system containing the fault or the location of the fault, but they give, merely, clues to aid in the investigation. The greatest intensity of the radiation from the power wires sometimes occurs at a considerable distance along the line from the fault. In patrolling the line containing a fault, it is noticed frequently that the indication in the radio receiver s very much less where the line is straight without taps, and increases slightly at a right angle turn in the line, in close proximity to taps and is very much greater near a dead-end. It has been found, also in several cases, that the source of interference on one system (the house lighting for example) may be induced into a secondary system (for instance: series street lighting system) and carried along the wires of the secondary system for a greater distance than on the primary system containing the fault.

By using a superheterodyne in an automobile this preliminary survey can be completed, very frequently, in a reasonably short time, and much valuable information obtained which will assist the investigator in his detail work, which will be described later.

The standard practice of opening individual circuits, in cases where it is convenient to interrupt the service, may determine on which circuit the fault exists. In making this test an observer should listen on a radio receiver while the different circuits are interrupted for a few seconds each. As some intermittent faults will not give an indication in the radio receiver the instant the power circuit containing the fault is switched on, it is advisable to switch off the power when the noise in the receiver is continuous, and note if the noise ceases at that instant.

Faults on street light circuits are often found during daylight, by the switching test.

When using a two or three-tube portable receiver it is necessary to place the loop of this receiver

within about twenty feet of the power line. Great care must be taken to avoid assuming that the fault lies in a limited district. This fact may be illustrated by describing an investigation which was conducted in Ottawa in November, 1925. The investigation was commenced in the Glebe district, where, by using a three-tube portable receiver, it was noticed that the house lighting wires in a district approximately 100 yards square strongly indicated a fault, while the house-lighting wires in the vicinity immediately surrounding this district gave little indication on the receiver. It was, therefore, assumed that this fault lay in this small district and much time was wasted in a local investigation. It was afterwards found that the radiation from the lines in nearly all parts of Ottawa was considerable, and, due to some peculiarity in the line, happened to be less on the streets immediately surrounding the district where the investigation was commenced. A survey of the whole city was then made and the fault was finally located near the Chaudiere Falls, a distance of approximately two and a half miles from the point at which the investigation had been commenced.

After a preliminary survey has been made, the detailed investigation should be carried out along the lines on which a fault is suspected. Faults may very often be found by careful inspection in cases where the preliminary survey points to a reasonably short section of the line. The sledge hammer method, however, has been found useful in locating about 90 per cent of the faults found by the Radio Branch on overhead distribution systems. This consists of tapping all the poles in the district, where the intensity of the radiation is greatest, with a sledge hammer of about six pounds' weight, and having someone listen on the radio receiver within view of the pole at the instant that same is struck. Very often, cases of intermittent faults may be located in this manner, as the jarring of the pole will usually either start or stop the spark. A slight click is heard in the radio receiver nearly every time a pole carrying electrical apparatus is vibrated, but if the signal in the radio receiver does not continue after an appreciable time a single, slight click, corresponding to each blow, does not necessarily indicate a fault.

In making this sledge hammer test, it is important for everyone to stand clear so that should the defective cut-out be so loose as to fall to the ground, when the pole is struck, it will not injure anyone.

A lineman was injured in Ottawa recently by a cut-out which was loosened by the shaking of the pole when a man was climbing, falling and striking his head. This accident, however, did not occur during a radio test.

Broadcast Listeners Very Often Assist in Locating Faults

In many towns in Ontario, broadcast listeners, either individually, or two or three friends working together, or an organized club, have assisted the public utilities in locating faults. Their assistance has been particularly useful in many cases of intermittent faults. It has often

been found that some really dangerous faults are so intermittent as to make a definite survey of the district with an automobile practically impossible. In such cases as this the broadcast listeners have become enthusiastic in the investigation and have spent many evenings observing and comparing their observations with those of their friends in different parts of the town, and in this way have provided sufficient information to enable the lineman to go to a small district and readily locate the fault by the sledge hammer test or by inspection.

Broadcast listeners have frequently supplied sufficient information to enable the linemen to directly locate the fault in a transformer cut-out by reporting that they have noticed the lights flicker very slightly at the instant great interference was heard on the radio receiver. In some cases the flickering of the light was so slight that it probably would not have been noticed had not the radio interference drawn observers' attention to the fact.

Some broadcast listeners have been known to be unreasonable in their demands on the public utilities by demanding similarly prompt attention to their radio complaints as they expect to get from the Fire Department.

A manager of a public utility recently received an "Order" from a broadcast listener in a small town to stop the radio interference forthwith. He replied that he would stop all radio interference as ordered at twelve o'clock that night, but to accomplish this it would be necessary to switch off all power and light from the town. The broadcast listener, who, by the way, was a prominent citizen and manager of the largest factory in town, considered this action rather serious, but the power man replied that he had received "orders" which would fix the responsibility on the broadcast listener who issued the instructions. The broadcast listener immediately changed his attitude.

Some public utility officials do not wish to acknowledge that their lines can possibly cause interference that can be heard on a radio receiver, for fear of the broadcast listeners blaming all noises they hear from their receivers on the power lines, but this attitude does not improve the good will of the consumers whose feelings become aggravated if they do not get a sympathetic hearing on the subject of radio. To many broadcast listeners, the reception conditions are apparently among the most vital subjects.

The number of false alarms or useless reports from broadcast listeners may be kept to a minimum by practical co-operation between public utilities and the broadcast listeners. This co-operation can best be put in practice through the medium of a radio club.

Radio clubs are now active in many towns throughout Ontario and are working in co-operation with the public utilities to their mutual advantage. Among the most active of these clubs may be mentioned those in London, Hamilton, Ottawa, Sarnia, Port Arthur and many others.

In many places the radio fans are individually working with the public utilities, assisting them in locating faults on their lines and improving local conditions for radio reception. Among such towns we mention Orillia, Allandale and Renfrew.

The Radio Branch, Department of Marine and Fisheries, is encouraging the formation of clubs and assisting them in dealing with inductive interference from power lines. A bulletin on radio interference has been sent to all clubs in Canada which are on our mailing list.

Every available opportunity is being used to educate the broadcast listeners along these lines and thus avoid a number of false alarms due to noises in the receivers, which the broadcast listeners or the radio dealer should correct without troubling the public utilities.

Work of the Radio Branch, Department of Marine and Fisheries

The Radio Branch of the Department of Marine and Fisheries recently organized its section for dealing with Inductive Interference. This Section is maintained from the proceeds of the sale of receiving licenses, which is one dollar per year for each radio receiver in use in Canada. There are now three especially equipped automobiles on tour in different parts of Canada and a number of additional cars are expected to be put into service shortly. These cars are manned by two radio electricians, who go from town to town investigating and arranging for the elimination of all the sources of radio interference which may be cured. These investigators instruct the superintendents of the local distribution systems in the latest means of locating faults on their overhead lines by the radio method. They also instruct radio dealers and individual radio fans who are interested in the methods of locating and eliminating the sources of inductive interference. The following is a summary of the sources of radio interference found by one of these investigators, on tour:

> Extract from report of investigator on tour with Car No. 3, in Ontario, between Ottawa and Galt, from June 3rd to August 13th, 1926—

Number of municipalities visited	65
Total number of sources of radio interference investigated.....	286
Faulty transformer cut-outs...	234
Other faulty series connections, including faults in disconnecting switches, terminals of transformers, etc...........	8
Contact with some ungrounded metal, such as cross arm bolt or bracket or transformer case.	8
Lines in contact with some high resistance ground, such as wet poles, trees, etc.............	4
Total faults on distribution systems......................	254

Tree Contacts

The radio receiver has been found very useful in giving warning of dangerous conditions where trees have come in contact with high voltage lines, and the portable radio

receiver has been successfully used to locate the actual position of many of these faults.

There is, very often, considerable opposition to the scientific trimming of trees by the distribution companies, from the general public and from the municipal authorities. We believe that this opposition is largely due to a misunderstanding of the circumstances. There have been a number of cases brought to our attention in which dangerous conditions have been located by means of radio, but, due to this opposition, the trees have not been trimmed until the branches have been badly burnt and thus caused greater damage to the tree than would have been the case if the tree had been scientifically trimmed. A case recently occurred in Ottawa where a branch of a tree fell across the primaries, causing a short-circuit and bringing the line to the ground, starting a fire. Fortunately, the fire was seen and extinguished before any serious damage was caused.

Description of Actual Investigations

We shall endeavour to illustrate, in the following sketches, certain difficulties encountered in our recent investigations and some of the methods used to overcome same.

A typical example of locating a fault on an overhead distribution system is exemplified in the following extract copy of report of the Ottawa investigator dated October 31st, 1925.

Reports of inductive interference were received from 301 Clemow Avenue and 520 Driveway. I first listened in to the interference on the receivers at each of these two places and found that it was of a similar nature. I then investigated each district with a portable receiver and found that the interference radiated, in both instances, from the electric light wires. It appeared to be of approximately equal strength over a radius of about 200 yards and was not as severe beyond this area. Accordingly, I made the usual test by means of the Bell Telephone, to determine if the interference at these two places was caused by the same source. To make this test, I went to 520 Driveway and telephoned 301 Clemow Avenue, and asked my assistant, who had been stationed there, to place the transmitter of the Bell Telephone near the radio loud speaker, in order that I might hear the interference by telephone. I then turned on the receiver at 520 Driveway and listened to the interference on this receiver with my right ear and the interference from the receiver at 301 Clemow with my left ear. I heard a break in the interference at 301 Clemow while the interference was continuous at 520 Driveway; also, the interference at both places burst into a loud roar at different times, showing that these two cases were produced by different sources. This result appeared to agree with the report of the patrol with the portable receiver, but it was considered necessary to make the second test, as results of patrol with a portable receiver are very often misleading.

It is very often found, when carrying a portable receiver along

the street, that the interference becomes less and then greater again, due to peculiarities in the radiating characteristics of the overhead wires, and very often the strongest interference is found some distance away from the source of interference.

The district near 520 Driveway was then investigated with a portable receiver and all the poles carrying transformers in this district were struck with a sledge hammer, while one man listened in on the portable receiver. When the pole at the corner of Broadway and Craig Sts. was struck the interference greatly increased, indicating a loose connection on this pole.

I traced the secondary wires from this transformer to the first house which it supplied and inquired at this house for the name of the company supplying the power. I telephoned immediately to the superintendent of this company, who at once sent a lineman to repair the fault. When the lineman arrived he listened on the portable receiver while the pole was struck, but the vibration caused by striking the pole, instead of causing the usual radio interference, caused the defective primary cut-out to fall to the ground, just missing the lineman's head. It was found that the contact jaws of this cut-out were badly burnt due to continuous arcing. It was reported that, during the minute this transformer was dead, the radio interference completely ceased in the district, proving beyond a doubt that this was the source of the interference reported.

The power company immediately repaired this defective cut-out, thus permanently eliminating this source of interference.

Fault on Series Incandescent Street Lighting System Located by Radio, in Ottawa, July 27th, 1926

A great number of reports of interference throughout the entire district supplied by the street lighting circuit were received by the Ottawa Hydro and by the Radio Branch, for a period of several weeks. At first the interference was very intermittent and many tests were carried out, switching on and off the street lights during the day, but the interference did not become apparent during these tests. On April 20th, the different street light circuits were switched on in the afternoon, one at a time, and it was found that the interference was apparently associated with Circuit No. 9, but, when the current was reduced by means of adjusting the constant current transformer, the interference was eliminated. Tests were then carried out to determine if the interference was due to a fault in the power house or on the line, but the interference was not again noticed until July 24th. When the interference remained steady, circuit No. 9 was supplied from a different transformer in the power house and conditions appeared to be the same as before, proving that the source was out on the line and not in the constant current transformer. No. 9 circuit was made alive in the afternoon and the line was patrolled with a portable receiver, in an automobile. It was

found that the interference was very great throughout the whole district served by this circuit, whenever the loop of the radio receiver paralleled this line within a distance of one hundred feet. The sound in the radio receiver was practically as great at a distance of one mile from the source, along circuit No. 9, as it was at the source, but varied somewhat in loudness. Each pole carrying a lamp connected with this circuit was struck with a sledge hammer and no change was observed in the noise from the receiver, caused by this fault, until the pole carrying the fault was struck. On several occasions poles which carried loose contacts on their circuits were struck, but these produced additional noise in the radio receiver and did not affect the constant sound due to the fault under investigation. These minor faults were attended to in due course. When the pole carrying the fault was struck with the sledge hammer, the interference became intermittent according to the vibration or swinging of the wires on the pole. Careful inspection by the lineman revealed the fact that the down lead of the series circuit supplying the lamp was in contact with the iron bracket supporting the lamp. The insulation was worn off this wire for a distance of about two inches and the copper conductor showed only very slight marks of burning. A test showed that this iron bracket was ungrounded, there being at the time fifteen megohms resistance from the bracket to ground.

The conditions found here are in every way typical of very many faults recently found on Hydro lines throughout Ontario, with the one exception that this particular fault was only indicated on the radio receiver when the full voltage was on the line. Inspection of the fault showed that the conductor was held away from the iron bracket by the thickness of a layer of paint, in such a way that the bracket became charged from the power line only when the voltage exceeded a certain critical value.

It is interesting to note that the response in the radio receiver, particularly a considerable distance along the line from the fault, is usually greater when the fault is due to contact with ungrounded metal than when the contact occurs with some high resistance ground.

The slight burning on the copper conductor was probably caused by current flowing down the pole in wet weather. Under these conditions, the sound from the radio receiver would probably be less than with the bracket thoroughly insulated from ground.

Means of Locating Faults on Overhead Distribution Systems by the "Radio Sledge-Hammer Test"

A loose connection in the cut-out of a transformer, which was found by radio recently, in Ottawa, was situated on one of three poles carrying a number of transformers and switches.

A decided response was noticed in the radio receiver when any pole within four spans of this corner was struck with a sledge hammer. This

was evidently due to the fact that the vibration from the blow of the sledge hammer travelled along the wires from pole to pole. After gently striking all the poles, the fault was localized to these three. By withdrawing the sledge a distance of about one and one-half inches from the pole and gently tapping each of these poles in turn, the fault was narrowed down to one pole. The lineman then climbed the pole and very gently shook the different wires, finally locating the loose connection in one of the transformer cutouts, the clamping screw of which had become loosened.

This fault was found as the result of an investigation lasting about an hour and a half, and, as it included the test of some thirty transformers, it is considered that the "radio sledge-hammer test" is the most economical method known of locating faults of this nature.

An Example of a Surge, Due to a Fault on a Power Line, Induced to Other Systems of Wires Which Run Parallel

A surge, due to a fault on a power line, may be induced from one line to another and conducted a greater distance on a secondary system than on the one on which the fault originated. These conditions were clearly shown by an investigation in Hamilton.

The indication of a fault on the power line was first observed by a broadcast listener on Victoria Street. Upon investigation it was found that the surge was carried on both the house-lighting and telephone wires. By tracing these wires with a portable receiver it was found that the response in the radio receiver was greater on the house-lighting primary wires on Victoria Street. These lines were followed along Victoria Street to King Street, and the radio receiver here indicated a greater surge on the street car lines. It was, therefore, believed that some fault existed on this system. After patrolling many miles of street car line, the greatest response was found on Burlington Street. In order to determine which system of wires was radiating this disturbance to the greatest extent, the portable receiver was placed under the various lines, where they run in different directions from the east end of Burlington Street. The receiver indicated a surge on practically every system of lines running along this street for a distance of about two miles, including telegraph, telephone, house lighting primary, street lighting primary and thirteen thousand volt Hydro. The greatest surge, however, was observed to be radiating from the thirteen thousand volt Hydro line supplying the Beach pumping house. This line was patrolled to the Beach pumping house, a distance of several miles and the fault was found on an ungrounded conduit containing a twenty-two hundred volt line from the transformer room to the pump motors.

Discussion

Mr. W. R. Catton, Brantford: We have a man who looks after radio troubles for the Electrical Club in our City, where we have both a 60 cycle and 25 cycle service. We found with the aid of a sledge hammer, a cut-out that was giving trouble at least a mile away from it, and was louder at the end of the sixty cycle primary than at the cut-out.

Mr. E. V. Buchanan, London: Mr. Chairman, I think Mr. Merriman's paper is one of the most interesting that has been presented to the Convention in many a day. It is my experience, and I suppose it is the experience of many receivers, that a radio receiving set is of very little use to the Manager of a Public Utility, because he never gets a chance to listen. He only gets a chance to listen to the other fellow's, when he goes out at night. He is called up so often by the other fellow, who has trouble, and told "Oh, you have a leaky transformer opposite my house." "How do you know?" "Because there is a noise in my receiver." I regret to say, Mr. Chairman, the Department has not been in London very frequently, and that is the only grievance London has against the Department. I am going to try to persuade the Local Commission to undertake this work seriously. But they have taken the attitude that it is not right for the Commission to expend the money of 18,000 hydro consumers for the benefit of 5,000 radio licensees, who have paid their license. I can hardly agree with that view point of the Commission, because I think the Department is doing itself just as much good in locating these troubles, because whilst at the present time there are radio interference troubles, there are incipient troubles on our own system. I would like to cite an instance that came to my own attention. I happened to go home one day at noon and tuned in on my receiver. In a few minutes a very loud noise commenced. I looked out the window and I found that the street lighting system was being tested out. They are switched on with the regulator in the up position, so that the street lights come on at about half voltage. I carefully watched the street light and immediately the regulator was lowered into its normal operating position, the noise vanished. Later, when the regulator was hung up, the noise came on again and continued until the current was switched off. I would like to ask Mr. Merriman if he has any explanation for that phenomenon. I was glad Mr. Merriman mentioned the intermittent trouble, because that has been our experience. We go out to search for sources of interference and they will immediately disappear. I know at my own house I have had interference for several months, and naturally about 90 percent of the work that has been done by the London Department in locating radio interference has been done in the vicinity of the Manager's house. Every day, the line Superintendent

comes to me and tells me "I have found your trouble," but the next evening the trouble recommences. Another thing that has been noticed is that a great many of the complainants call up and say they know this interference is on the street lighting circuits, because it immediately comes on when the street lighting circuits are switched on. We have been investigating these street lighting circuits, and we have been unable to detect any trouble in them. We have gone over the circuits and pulled every lamp on the circuit and listened in and still the noise continues. I have been wondering if it is possible that the street lighting circuit broadcasts interference only when the circuit is alive. There doesn't seem to be any reason why it should be, but there is just a possibility that that may happen.

Mr. S. B. Iler, H.E.P.C. of Ontario: In speaking of the question of radiation from a street railway circuit, you use the expression "near". I was wondering if you could give that in terms of feet. If I heard correctly, a contact with the ungrounded metal, such as a street lighting bracket, is a cause of greater radiation than a contact with grounded metal. In one town in the East, we have run into a form of interference which appears on the Bell Telephone service from a series street lighting transformer, operating at six amperes primary and twenty amperes secondary. When the lamp burns out there is interference in the Bell Telephone service, and I assume on radio services. I feel we should call the manufacturers' representatives attention and possibly the manufacturers as well to the inefficiency of our transformer cut-outs.

Chairman: I might answer Mr. Iler's suggestion by saying there is a new cut-out being developed and will be on the market shortly.

Mr. Willis Maclachlan: Mr. Chairman, there is one point I would like to bring out that Mr. Merriman has found, and that is that a contact between a primary and ungrounded transformer case is a source of grave danger. Look at the position of your average lineman in climbing a pole and coming in contact with a transformer case that is not grounded. The climber goes up and his feet may come in contact with the grounded neutral on the secondary, and if he puts his hand on the ungrounded transformer case, that is in contact with the primary, you know the result. We have, unfortunately, to investigate some of these results. This field of being able to locate that very difficult type of trouble deserves, I think, a great deal of credit.

Mr. R. J. Smith, Perth: I would like we to tell you some experience we have had with interference on a street lighting circuit. About three years ago, we had complaints from radio listeners, and they truly had ground for complaint. We investigated it for three weeks. We spent nights patrolling the line doing everything we possibly could to locate the trouble. We finally traced it to the old type of transformer. One of the flexible leads on this transformer had become broken through. When we put a new lead on, our troubles

were over for the time being. Again, this fall, we had something similar. We examined the transformer, but found it in good condition. Finally a car from the Department came over, and they found a contact on the inside of a lamp head. The asbestos covered wire had become bare and was just touching the metal. The direction in which the wind was blowing, seemed to affect the interference. This would have been very difficult for us to find without the assistance of the Departmental car. Troubles of that kind are very difficult to locate, without such equipment as Mr. Merriman has shown us to-day, and I am sure we appreciate very much the assistance we are receiving from the radio department at Ottawa in locating our troubles.

Mr. C. E. Schwenger, Toronto: We have discovered the majority of these troubles are in cut-outs. I have been wondering whether Mr. Merriman had found an oil cut-out any better. This cut-out, of course, is iron-clad, but I was wondering if it re-radiated at all.

Mr. J. R. McLinden: We made up a portable set of our own and went around and tested our transformers, but found no trouble except in the cut-outs. We had trouble on and off with a flash sign, and could not devise anything to overcome it. Since then, the Government officials came and located the same trouble. They promised us a choke coil to put on to remedy that trouble. Outside of a little trouble with the telephone company, we have had very little of it. There is another thing that perhaps this organization does not know very much about, and that is a radio outfit with an attachment to it to test insulators when the current is on the line, that has been devised by Mr. Tom Berry. I think it is a very marvellous piece of equipment and is going to be much needed on all lines. Each insulator can be tested separately and a record made of it so that it can be changed later.

Mr. H. O. Merriman: As there are just a few moments left, I will endeavour to speak on a few of the points brought up in the discussion, very briefly, and would like to have an opportunity of going into some of these questions in greater detail, at some future time.

With reference to Mr. Buchanan's experience in connection with the street lighting circuit in London, which caused interference when the street lights came on at about half voltage and the interference disappeared when the voltage was brought up to normal, this may have been caused by some fault which was only apparent when the auto transformer was in a certain position. I have experienced the reverse condition in connection with a fault on the street light system in Ottawa. The interference was caused by the lead to the lamp resting on a painted iron bracket and was held away from the iron so as to produce an air gap which broke down only at normal voltage and when the auto transformer was adjusted to reduce this voltage the interference disappeared.

With regard to Mr. Iler's question regarding the interference on a radio

receiver near a street railway circuit, we have noticed that most of this interference is apparently due to the magnetic field surrounding the trolley wire and not so much due to electric radiation. Many broadcast listeners have reduced their interference from this source by installing their aerials in the rear of their houses rather than in front, to increase the distance between their aerials and the trolley wire.

With regard to the interference, which affects both radio receivers and the Bell Telephone Company, we find that a great deal of the interference which affects the Bell Telephone Company is due to the magnetic field from the power wires and is usually a disturbance at audio frequency rather than at radio frequency. There are, however, some cases which affect both the telephones and radio receivers. Mr. Schwenger referred to oil cut-outs as possibly not causing so much radio interference on account of the fact that they were thoroughly shielded. Although there would probably be no direct radiation from the cut-out in an iron box which was gounded, the interference from a fault in this iron box would be caused by a surge on the line and would radiate from any open wiring connected to such a fault. As far as I remember, in the few cases of oil cut-outs which have been brought to our attention as causing radio interference, it has been found that the oil had been drained out and a defect occurred in the cut-out.

In connection with the prevention of interference from flashing signs and other electrical apparatus, we find that nearly every case requires special treatment. We have a number of circulars describing means of suppressing interference from various types of electrical apparatus, which the Department would be pleased to send to anyone interested.

I am sure the time is up, but, if there are any other questions I would be very pleased to try to answer them, and, if convenient, a few additional remarks may be included in the "Report of the Discussion".

ADDITIONAL REMARKS

Which, Owing to Lack of Time, Were Not Included in the Reply at the Convention.

I was very interested in Mr. Buchanan's remarks showing why it is an advantage to the Public Utilities to investigate reports of radio interference. This is the point of view taken by many Public Utilities in Canada and the United States and is clearly expressed in the Report on Radio Interference published by the National Electric Light Association.

Another point, in this connection, which we often hear expressed is the fact that the broadcast listeners consume a considerable amount of electricity. We have recently heard from Saskatchewan that it has been observed several times that the load, after eleven o'clock at night, is considerably greater when radio reception is good.

Mr. Buchanan mentions the fact that many broadcast listeners report that interference is caused by the

street light system, as they have observed that the interference starts when the street lights are switched on. We have received many similar reports but often find that they are misleading if the observer is not very careful to notice if the interference starts the very instant the lights are switched on. Broadcast listeners, who have a pre-conceived idea that the interference is in the street light system, may listen to their radios in the daytime and observe no interference, and, again, at night, they will hear interference which may be intermittent, or they may observe that the interference starts about the time the lights are switched on. In many cases this is a mere coincidence, as the interference has been starting and stopping many times throughout the day and night and it happens that the recurrence appears to coincide with the switching on of the street lights. A more reliable test, to determine if the interference is from the street light system, is to switch off the street lights several times and observe if the interference disappears the instant the lights are switched off.

Association of Municipal Electrical Utilities

Report of the Merchandising Committee

The Merchandising Committee held two meetings during the past year, one on April 16th, 1926, and one on September 22nd, 1926, and at these two meetings several items of importance were discussed and recommendations made accordingly.

At the first meeting the question of further detailing Hydro shop operating expenses was taken up, as well as the proper method of handling time payments, and arising out of this meeting the supplementary rules for the operation of Hydro shops came into being. Copies of these rules have already been distributed to all Hydro shops, and are being applied to 1926 operation.

At this meeting also the question of standard lien note forms was taken up, and it was decided that a standard form of lien note should be in use in all Hydro shops. Accordingly, all municipalities were requested to send in copies of their lien notes to have them looked over by the Legal Department of the Commission, and a suggested standard form produced to serve all municipalities. This was done, and after the Legal Department had produced a standard form, copies of this were sent out to all municipalities for their comments. Upon the return of these forms with the suggested changes submitted by solicitors in various municipalities, the entire matter was again submitted to our Legal Department, in whose hands it rests at the present time. As soon as they have disposed of it and produced another revised standard form, copies will be mailed to

each Hydro municipality with the recommendation that the material contained in that form be utilised in preparing lien notes forms in the future.

It is not the intention to have forms prepared and printed by the Commission to supply each Hydro municipality, because of the local color which is necessary in all documents of this kind.

The question of longer discounts from the manufacturers was also given considerable discussion, and it was decided that all municipalities interested in merchandising the major electrical appliances should endeavor to influence manufacturers to advance the scale of discounts to enable Hydro shops to merchandise, stock and service their appliances efficiently, and not suffer financial loss in the operation. It was also decided that in all cases Hydro shops should not sell below the standard re-sale price set by the manufacturers except in extreme cases where dead or re-possessed stock have to be liquidated.

The question also of membership of the Hydro-Electric Power Commission in the Society for Electrical Development was discussed, but it was felt that the time was not yet ripe for participation by the Commission in the movements inaugurated by this Society. Until a Provincial organisation is in existence supported by a large number of Hydro municipalities, the Commission can take no active part in development work such as is carried on by the Society for Electrical Development.

It is felt by the Committee that some very useful work was accomplished during the past year, and it is hoped that by the co-operation of Hydro shops, better operation will result from the work the committee has done.

Respectfully submitted.
(Sgd.) V. S. McIntyre,
Chairman.

Minutes of Executive Committee Meeting

A meeting of the Executive Committee was held at the King Edward Hotel on Thursday, January 20th, beginning at 5 o'clock p.m. Those present were: Messrs. J. J. Heeg, Chairman; T. J. Hannigan, J. G. Jackson, J. G. Archibald, R. J. Smith, R. H. Starr, C. T. Barnes, D. J. McAuley, W. R. Catton, O. H. Scott, C. A. Maguire and S. R. A. Clement, Secretary.

This meeting was called for the purpose of arranging Committees for the year 1927 and transacting any other business that should come before it. A memorandum from the Ontario Municipal Electrical Association was read advising that at a meeting of that Association on the previous day a Resolution was passed recommending the desirability of holding the next Summer Convention at Niagara Falls. The Secretary advised of having discussed the question of dates with the management of the Clifton Hotel that afternoon.

It was moved by Mr. R. H. Starr and seconded by Mr. W. R. Catton,

that the Summer Convention be held at the Clifton Hotel, Niagara Falls, on June 23, 24 and 25th,—the delegates to arrive on the evening of the 22nd.—*Carried.*

The Chairmen of the various Committees, whose appointment would be made later at the meeting, were instructed to proceed at once with the preparation of plans for the Summer Convention, keeping in mind these dates, the mornings of which would be used for business sessions and the afternoons and evenings for recreation and sight-seeing, and be prepared to report complete plans at a meeting of the Executive Committee to be held sometime during the first week of April on the call of the President.

Committees for the year 1927 were drafted as follows:

Papers Committee: Mr. W. R. Catton, Brantford, Chairman; Messrs. V. S. McIntyre, Kitchener; J. E. B. Phelps, Sarnia; C. W. Baker, Packard Electric Co., St. Catharines; Jos. Showalter, Canadian Westinghouse Co., Toronto; W. P. Dobson and J. H. Caster, H.E.P.C. of Ontario, Toronto.

Convention Committee: Mr. J. G. Archibald, Woodstock, Chairman; Messrs. J. E. Teckoe and H. P. Stephens, Niagara Falls; A. W. J. Stewart, Toronto; M. B. Hastings, Powerlite Devices Ltd., Toronto; Wm. McKenzie, Sterling Electric Co., St. Catharines; F. Mahoney, Canadian General Electric Co., Toronto; J. W. Purcell, H.E.P.C. of Ontario, Toronto.

Regulations and Standards Committee: Mr. R. J. Smith, Perth, Chairman; Messrs. J. E. B Phelps, Sarnia; J. R. McLinden, Owen Sound; Geo. Grosz, Waterloo; O. A. Hunt, London; W. P. Dobson, H.E.P.C. of Ontario, Toronto; and A. G. Hall, Electrical Inspection Department, Toronto.

Committee on Accident Prevention and Health Promotion: Mr. J. G. Jackson, Chatham, Chairman; Messrs. C. T. Barnes, Oshawa; H. G. Hall, Ingersoll; R. L. Dobbin, Peterboro; C. E. Brown, Meaford; C. E. Schwenger, Toronto; E. V. Buchanan, London; F. C. Adsett, Trenton; T. C. James, G. F. Drewry and Wills Maclachlan, H.E.P.C. of Ontario, Toronto.

Merchandising Committee: Mr. O. H. Scott, Belleville, Chairman; Messrs. O. M. Perry, Windsor; V. S. McIntyre, Kitchener; A. O. Hunt, London; C. W. Burns, Walkerville; W. H. Childs, Hamilton; I. N. Pritchard, Chatham; A. B. Scott, Galt; A. W. J. Stewart, Toronto; J. E. B. Phelps, Sarnia; H. F. Shearer, Welland; and G. J. Mickler, H.E.P.C. of Ontario, Toronto.

Rates Committee: Mr. V. S. McIntyre, Kitchener, Chairman; Messrs. P. B. Yates, St. Catharines; E. I. Sifton, Hamilton; E. M. Ashworth, Toronto; R. L. Dobbin, Peterboro; E. V. Buchanan, London; D. B. McColl, Walkerville; A. B. Scott, Galt; J. W. Peart, St. Thomas; Geo. Grosz, Waterloo; O. M. Perry, Windsor; and all of the members of the 1927 Executive Committee.

Auditors: Messrs. W. G. Pierdon, H.E.P.C. of Ontario, Toronto, and H. P. L. Hillman, Toronto.

It was moved by Mr. O. H. Scott and seconded by Mr. C. T. Barnes

that the draft of Committees for the year 1927 be adopted.—*Carried.*

It was moved by Mr. O. H. Scott and seconded by Mr. R. J. Smith that the Secretary be instructed to purchase a gong for the use of the President when acting in the capacity of Chairman.—*Carried.*

It was ruled that the reports of all Committees to be presented at Conventions be printed and circulated among the membership prior to the Convention.

It was moved by Mr. R. H. Starr and seconded by Mr. O. H. Scott that the Secretary and retiring Treasurer be paid an honourarium for the past year, the same amount as in the preceding year.—*Carried.*

There being no further business, the meeting adjourned at 6 o'clock.

A Methuselah Among Lamps

Extraordinarily long life always excites interest and usually prompts the analytical mind to attempt to solve the riddle of the longevity under consideration. This is probably due to the inherent desire in all of us to profit by another's experience and last as long as we can. The smoker and the boozer take great comfort in the knowledge that a centenarian had his (or her) pipe immediately after the nursing bottle and did not bother about the flavor of chlorine in the water as long as prohibition was not too strenuously enforced. The reason for long life was thus evident. On the other hand, the total abstainers and the non-smokers are equally jubilant over the news of a centenarian of non-indulgent habits and, of course, the reason is again obvious.

In spite of these pros and cons people and things occasionally last much longer than their normal time of existence. As an example of this we have just received at the laboratory a 6.6 ampere series lamp installed at Collingwood on February 26, 1913, which was at the time of the official opening of Hydro service in the town, and removed from service without having burned out on November 29, 1926 (real pre-war stuff). This lamp was of the hair-pin filament, vacuum type and was carefully brought to Toronto for measurement. However, like aged folks the rigors of travel were too much and the filament was broken during the trip.

Based upon an average burning-hours per year of 4,010 this lamp has the very creditable record of over 55,000 hours of burning. Of course, a measurement of its light output and efficiency would have been very interesting if the lamp had been able to withstand the journey. Contrary to what might be expected, the discoloration of the bulb is remarkably slight; in fact it is no worse than ordinary 60 watt vacuum lamps at the end of normal life. Evidently it did not smoke. The deposit on the bulb is of a brownish color. The filament has the well-known appearance of thorough crystallization; it appears rough and on examination through a magnifying glass the surface is seen to be composed of innumerable minute facets that glisten when the light shines upon it.

The label is gone, but by comparison with other similar lamps it is evidently of 80 c.p. rating. During its term of service it has consumed about 4,400 kw-hrs. and has produced about 43,700,000 lumen-hours of light which is the equivalent of 1-1,000 watt gas-filled lamp for about 2,300 hours.

This is indeed a very extraordinary case of long lamp life which is difficult to explain. Even with the most perfect uniformity of filament it seems incredible that during such a long period of burning resulting in complete crystallization of the filament the expansion and contraction caused by the closing and opening of the circuit have not resulted in failure years ago.

If lamps possess spirits it may be assumed that the spirit of this lamp is enjoying well earned rest in that happy place where line surges cease to roll and where there are neither sleet storms nor boys to throw stones.

O.H.E.C.

Card Party and Dance

Those members of the staff who were so unfortunate as to be unable to attend the Ontario Hydro-Electric Club card party and dance, which was held in Columbus Hall, Friday evening, February 4th, missed a really enjoyable evening.

As announced on the poster advertising the event, the Entertainment Committee asked for the support of all members of the Club in making it an evening long to be remembered, and it was very gratifying to them to see such a large turnout of our club members and their friends, and to learn on checking up the attendance that there were over five hundred guests.

Chas. E. Bodley and his Radio Orchestra furnished the music for dancing, which was all that could be wished for and contributed largely to the success of the evening's entertainment.

In connection with the card party, there were eleven tables of euchre and seven tables of bridge. First and second prizes were awarded the lady and gentleman winners of these events.

The Entertainment Committee was composed of the following O.H.E.C. members:

Misses J. L. Burton, E. Anderson, M. Evans.

Messrs. A. H. Frampton, J. F. Whitehead, S. L. Eisenhofer and E. F. Latimer.

The next "get together" will be the club picnic. Arrangements have been made to hold this at Queenston on July 7th.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

HYDRO NEWS ITEMS

Central Ontario District

Estimates are being prepared for the addition of a 50 kw. transformer to the present Marmora Station to take care of a new power customer.

* * * *

The Cobourg Rural District went into operation on February 1st, a number of extensions in this district are contemplated.

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Georgian Bay System

The Township of West Gwillimbury has recently completed an agreement with the Bradford Hydro-Electric Commission covering the delivery of approximately 120 h.p. to be used by the Township for pumping purposes in the reclaiming of some 7,000 acres of marsh adjacent to the Village of Bradford.

The work of reclaiming the Holland Marsh was started in 1925 and it is expected that the necessary construction work will be completed early this summer.

In order to make delivery of this power it will be necessary to increase the capacity of the substation at Bradford from 150 to 300 kv-a. and also to make some extensive changes in the distribution system of the village.

The necessary substation and distribution system changes are to be proceeded with immediately.

Niagara District

The power requirements of the Woodstock Rural Power District have grown to such an extent that the present bank of 3-37-½ kv-a. transformers are about to be replaced by a new substation of 450 kv-a. capacity.

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The Commission is constructing on behalf of the Merritton Hydro-Electric Commission additions to its substation equipment. This was made necessary on account of increasing power loads.

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Nipissing System

The Commission has approved the formation of a rural power district for the Township of West Ferris, immediately south east of the City of North Bay, and service will be given during the coming summer to suburban, rural, and summer residents in that district.

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Ottawa System

Arrangements have been made for the installation of Street Lighting Systems in the Police Villages of North Gower and Osgoode in Nipean Rural Power District.

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in February, 1927.

Appliances

BLUEBIRD LIMITED, Brantford, Ont.

Heating unit for attachment to tub of washing machine.

* * * *

HAMILTON BEACH MFG. CO., Racine, Wisconsin.

Drink Mixers, Model 10.

* * * *

HOUSE ELECTRIC HEATING CO. INC., 1061 Rue Bleury, Montreal, Que.

Electric hot water furnace.

* * * *

JEWELL ELECTRICAL INSTRUMENT COMPANY, 1650 Walnut St., Chicago, Ill.

"Jewell" A-B Relays, Types 593 and 595.

* * * *

R. A. LISTER & CO. (Canada) LIMITED, Lottridge St., Hamilton, Ont.

Electric Lighting Plants.

Marking: Nameplate with rating on generator. The name of the manufacturer is marked on the frame of the plant.

* * * *

RENFREW ELECTRIC PRODUCTS LTD., Renfrew, Ont.

Bowl type reflector heater. "Beaver", Cat. No. 85.

Marking: Nameplate with manufacturer's name and the rating in volts and amperes.

SPERLICH AND UHLIG COMPANY, 38 Piquette Avenue, Detroit, Mich.

Portable 24″ ironing machine. "Ironrite Dufold".

* * * *

SOUTHERN ELECTRIC COMPANY, 27 Wilton Square, Toronto.

"Hubbell Electric Rangette"—combination hotplate and bake oven.

* * * *

UNITED DRUG CO. LIMITED (Submittor), 68 Broadview Ave., Toronto, Ont.

THE FRANK E. WOLCOTT MANUFACTURING COMPANY (Mfr.), Hartford, Conn.

"Electrex" upright toaster. Cat. No. 400X.

* * * *

*JOHNSON SUPER FUEL OIL BURNERS OF CANADA (Submittor), 150 King St. W., Toronto, Ont.

SUPER OIL HEATER CO., THE (Mfr.), 275 Connecticut Blvd., Hartford, Conn.

Fuel Oil Burner, Type "B".

* * * *

THE UNIVERSAL TEST EQUIPMENT CO., (Submittor), 313 Continental Life Bldg., Toronto, Ont.

UNIVERSAL TEST EQUIPMENT CO., (Mfr.), 2939 Oakley Ave., Chicago, Ill.

Universal Tester and Trouble Shooter.

* * * *

ALTORFER BROS. CO., Peoria, Ill.

Cleaning Machines—Washing Ma-

chines. Superelectric, Models 65 and 66, Oscillator Type, Model 85, Dolly Type, Models 53 and 54.

* * * *

*BRACH MFG. CO., L. S., 127-129 Sussex Avenue, Newark, N. J.

Radio Appliances (As listed on Underwriters' Laboratories card dated December 10, 1926).

* * * *

*JEFFERSON ELECTRIC MFG. CO., 501-11 S. Green St., Chicago, Ill.

Bell-ringing Transformers (As listed on Underwriters' Laboratories card dated October 26, 1926).

* * * *

*NELSON CORP., THE HERMAN, Moline, Ill.

Heating and Ventilating Units—"Univent", Models R and S.

Marking: Nameplate with trade name and rating.

* * * *

*PHILADELPHIA STORAGE BATTERY CO., Ontario and C Sts.,Philadelphia, Pa.

Radio Appliances—"Philco" Radio A, B and AB., Cat. Nos. A-603, A-253, B-603, B-253, AB-663, AB-623, AB-463, AB-423, TC-60, TC-25.

Marking: "Philco".

* * * *

Fittings

K. T. FOUNDRY COMPANY, Galt, Ont.

"KT" in a diamond No. 14 U.S. gauge stamped steel conduit box covers.

*RODALE MFG. CO., 492 Broome St., New York, N.Y.

Composition attachment plug, Cat. No. P-27.

Marking: "Rodale" molded in face of plug.

* * * *

Switches

RE-P-TO AUTOMATIC DOOR SWITCH CO., 77 Beaubien St., Montreal, Que.

"Re-P-To," single-pole door switch.

* * * *

*GEM ENGINEERING CORPORATION, Hempstead, N.Y.

Sign Flashers (As listed on Underwriters' Laboratories card dated June 23, 1925).

* * * *

*INDUSTRIAL CONTROLLER CO., Milwaukee, Wis.

Resistance Appliances (As listed on Underwriters' Laboratories card dated December 24, 1926).

* * * *

Miscellaneous

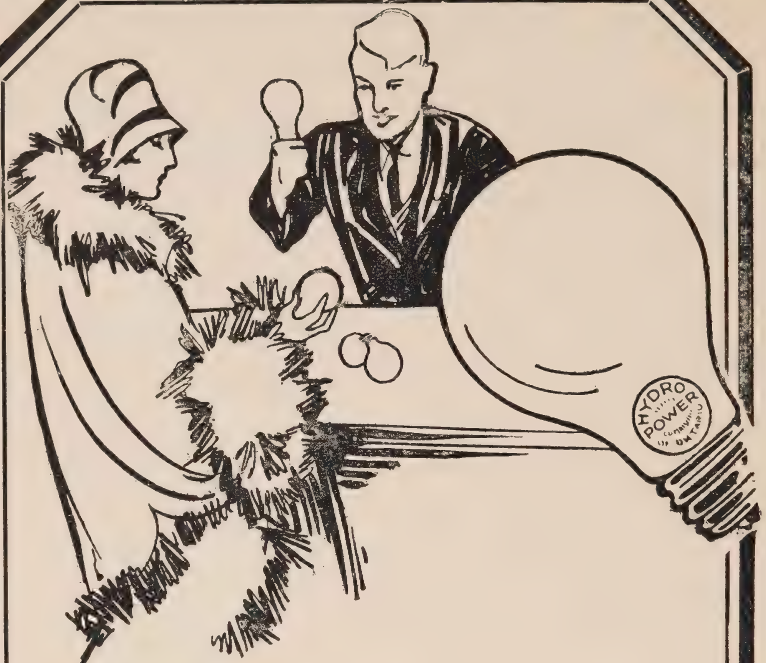
*FLEX-I-CON MFG. CO. LTD., 4492 Des Erables St., Montreal, Que.

Armored Cable.

Marking: Green and maroon threads woven in overall braid of conductors.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.



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Hydro-Electric Power Commission of Ontario

5

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THE BULLETIN

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Some Features of Toronto Distribution Stations

By P. E. Hart, Chief Engineer, Toronto Hydro-Electric System

(An abstract of a talk given before the Electric Club of Toronto).

IT is interesting to look back (comparatively only a few years) to when the System started, and compare that with the present time.

The preliminary stages of our power development were initiated in the year 1903 when the Ontario Legislature passed an Act entitled, "An Act to Provide for the Construction of Municipal Power Works and the Transmission, Distribution and Supply of Electrical and other Power and Energy." This was followed by the Act of 1906 and Amendment of 1907, known as the Power Commission Act, with further Amendments in the years following. In 1908 the City of Toronto entered into a contract with the Hydro Electric Power Commission of Ontario, and made application for an initial block of power amounting to 10,000 h.p. all in accordance with the schedule contained in the Act of that year.

It is of interest to note that at that time and for several years afterwards there were considerable, and, in fact, very serious doubts in the minds of many persons pertaining to the wisdom of making this contract, and skepticism was freely expressed concerning the ability of the City of Toronto to find use and market for such a large block of power as 10,000 h.p., over and above the load already being supplied which amounted to about 35,000 h.p.

The construction of the distribution system in the City of Toronto was commenced by the city as a branch of the municipal service in the year 1910, under the jurisdiction

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of the then City Engineer, Mr. C. H. Rust, assisted by the late Mr. K. L. Aitken, who became the first Managing Engineer. Their rights and powers were subsequently, by Chapter No. 119 of the Ontario Statutes of 1911, vested in a board of three commissioners styled "The Toronto Electric Commissioners." The first commissioners appointed were: Mr. P. W. Ellis, Chairman; His Worship Mayor Geary, now Colonel G. R. Geary, K.C., Corporation Counsel and M.P., and Mr., now Sir Henry P. L. Drayton. The present Commissioners are: Mr. P. W. Ellis, Chairman, he having occupied this position since the first appointment, Mr. Geo. Wright of the Walker House, and His Worship Mayor Foster.

The Toronto Hydro Electric System went into actual service operation on March 24th, 1911, with a load of approximately 800 h.p. However, we find by July of that year the load had reached 1,600 h.p., and by the end of the year 1911 had reached 5,000 kw. At the end of 1912 the load had passed 12,000 kw., and by the end of 1915 amounted to approximately 30,000 kw. or over 40,000 h.p., whereas many people had doubted the city's ability to absorb 10,000 h.p. but a few years before.

In the year 1922 the plant of the Toronto Electric Light Co. was absorbed into the Toronto Hydro-Electric System; the load so taken over was about 40,000 kw. and included the power distributed by that company, to the T.T.C. By this time the T.H.E.S. load alone amounted to about 65,000 kw., making a total for that year of 105,000 kw. or 140,000 h.p. The System load for the year 1926 just ended, was about 165,000 kw. or 220,000 h.p. We are now making preparations to handle 250,000 h.p. by the end of this year.

Such growth of load has called for a programme of almost continuous construction in order to keep ahead of the demand, which is still growing. There is every reason to believe that the increased demand for the next decade will at least keep pace with what has already gone before, and this may possibly be exceeded.

A glance over the accompanying illustrations will give an appreciation of the physical magnitude of some of our larger stations.

An interior view of Strachan Avenue Terminal Station is shown, where power is received from Niagara

1—Interior View Strachan Ave. Terminal Station.

2—Duncan St. Station.

3—Carlaw Station as at present.

4—The Original Transformer House which stood on the site of present Carlaw station.

5—Supervisory controlled station at Danforth and Morton Aves.

6—Interior View of High Level Station.

at 110,000 volts and is stepped down to 13,200 volts for distribution to the various substations throughout the city. The view is taken down the centre aisle with a portion of the 13,200 volt switching equipment on the right.

An illustration is also given which shows an exterior view of Duncan Substation, one of the largest on the System. This station has been trebled in size since first built.

Carlaw Avenue Substation is next shown. This station has been extended once since originally built, and many of us can remember the original transformer house, standing on the same site, a small building built of concrete slabs with a red tile roof.

Our High Level Substation has grown from a comparatively small building to one 92 ft. wide and 167 ft. long, with an ultimate capacity well in excess of 70,000 kv-a. Danforth is the first of our newer stations built around the idea of complete remote or supervisory control. It is controlled from Carlaw Substation over four or five wires, and under normal operating conditions no attendance in the station is required.

Wiltshire Avenue Station, is on a site south of Davenport Road and close to the old Toronto and Niagara Power Company's right-of-way where the Ontario Hydro-Electric Power Commission has erected an outdoor transformer station supplying it at 13,200 volts. In addition to being a terminal station for that section of the city it is also a distributing station for the load in the immediate vicinity with a present installed transformer capacity of 12,000 kv-a., provision being made to add to it as load conditions require.

While time has permitted our taking but a brief glance at what may be termed "The Principal High Spots," there is much more of interest, even from the distinctly engineering aspect

High Level Sub-Station.

Stations on Wiltshire Ave.

of our enterprise, particularly with regard to details. However, this brief review will serve to convey to you some impression of what we have been and are doing here in Toronto, in order to provide citizens with the comparatively low price electrical energy now available, aiding so much in the doing of all kinds of every day work and providing in no small measure for our comfort. Imagine but for a moment what conditions of life would be if we had no such thing as electrical distribution of power, and then realize that this has all come about within the lifetime of most of us, and touches our lives at every point.

Notwithstanding the fact that everything used for this service in the way of labor and material has materially increased in price since the period before the war, nevertheless, the cost of electrical energy to consumers in Toronto has not increased and is only about one-half the cost before the Toronto Hydro-Electric System went into operation. It is about the only thing that has not increased in price. This has been accomplished notwithstanding the fact that electrical power for distribution actually costs much more to produce.

For the future, if the Toronto Hydro-Electric System continues to receive the same favorable public support that it has enjoyed in the past, with capable, wise and sympathetic Commissioners and Management to guide its destinies, and with the active co-operation of staff and employees all down the line, the success of this publicly owned enterprise is assured. In the years to come there will then be even more reason to be thankful to those, who some years ago had the foresight, initiative and courage to get started for the public benefit, the System that we now possess.

There has already been much accomplished, but there still remains more to do. There is room for a wider use of electrical energy

in the every day service of mankind, "especially in the home," and as time goes on it will continue to contribute in no small measure towards the emancipation of humanity from the more irksome kinds of labor, permitting more to be done, or the same work to be accomplished in shorter time—thereby tending to increase the period that may be given to other desirable activities. Therefore, the business of supplying electrical power throughout a community is, of itself, a very important and beneficial public service that far exceeds the limits of its money value. *The Bulletin of Toronto Hydro-Electric Club.*

Municipal Progress During 1926

IT is difficult to get an adequate of conception of the magnitude the Hydro enterprise from a Municipal standpoint. Each municipality has its own balance sheet and operating report and a definite knowledge of what takes place, but it is necessary to combine all such reports into one consolidated report in order to view the system as a whole.

For this purpose the balance sheets of the Municipal systems have been combined and are shown comparatively as follows,—

COMBINED BALANCE SHEETS, 1925 AND 1926

ASSETS:	1925	1926
Total Plant	$56,904,902.27	$60,616,620.95
Bank & Cash Balance	1,700,145.30	2,136,290.79
Securities & Investments	1,095,662.92	1,674,317.49
Accounts Receivable	3,417,558.86	3,234,816.81
Inventories	1,711,504.13	1,397,667.83
Sinking Fund on Local Debs	5,202,451.70	5,599,675.01
Equity in Hydro System	7,551,588.70	8,046,868.53
Other Assets	137,280.05	33,151.81
Total Assets	$77,721,093.93	$82,739,404.22
LIABILITIES:		
Debenture Balance	$37,919,225.01	$39,602,533.48
Accounts Payable	3,139,067.92	3,118,684.78
Bank Overdrafts	226,147.82	163,725.53
Other Liabilities	1,075,914.83	1,087,795.08
Total Liabilities	$42,360,355.58	$43,972,738.87

RESERVES:

For Equity in H E.P.C.	$ 7,551,588.70	$ 8,046,868.53
" Depreciation	8,699,437.68	9,360,322.27
Other Reserves	1,157,147.20	947,970.23
Total Reserves	$17,408,173.58	$18,355,161.03

SURPLUS:

Debentures Paid	$4,440,138.34	$5,493,879.83
Local Sinking Fund	5,202,451.70	5,599,675.01
Add'l Operating Surplus	8,309,974.73	9,317,954.48
Total Surplus	$17,952,564.77	$20,411,509.32
TOTAL Liabilities, Reserves and Surplus	$77,721,093.93	$82,739,404.22
Percentage of net debt to Total Assets	57.2%	55.5%

The outstanding features of this comparison are that while total assets increased 6.5 per cent., the increase in total liabilities was but 3.8 per cent. The Depreciation Reserve and Surplus now stand at $29,771,831.59 or 49 per cent. of the total plant cost. The percentage of net debt to total assets now stands at 55.5, a decrease of 1.7 per cent. during the year. Reference to previous reports show this percentage as 88 in 1913 with an average annual reduction of 2.3 per cent. This is the final balance sheet record of the satisfactory financial standing of the municipalities.

The comparative operating reports are equally interesting.

COMBINED OPERATING REPORTS 1925 and 1926

REVENUE:	1925	1926
Domestic Light	$ 6,723,539.06	$ 7,660,191.25
Commercial Light	3,901,219.58	4,225,959.77
Commercial Power	6,658,973.90	6,868,005.94
Municipal Power	1,367,596.20	1,922,512.34
Street Lighting	1,441,769.50	1,492,385.10
Miscellaneous	326,016.26	508,944.88
Total	$20,419,114.50	$22,677,999.28

EXPENSES:

Power Purchased	$10,661,300.64	$12,326,255.18
Operation, Maintenance & Admin	4,352,133.77	4,551,856.16
Debenture Charges	3,245,531.91	3,465,120.44
Depreciation	1,079,870.42	1,157,579.05
Total Expense	$19,338,836.74	$21,500,810.83
Net Surplus	1,080,277.76	1,177,188.45

The number of municipalities operating at a loss is being gradually reduced as is shown by the following,—

	1925		1926	
	No.	Amount	No.	Amount
Municipalities showing gross deficits.	26	17,828.08	10	3,904.17
" " net deficits..	42	91,491.97	25	19,676.00

The net surplus for the year in all municipalities was $96,910.69, greater than in 1925 and is the largest for any year since the beginning of operation by $13,278.35.

The debt reduction payments on municipal debentures taken into 1926 expenses as part of the cost of operation amounted to $1,362,577.88. Due to the general use of installment debentures, this item is growing very rapidly, the increase in 1926 being over $58,000.00 with a corresponding decrease in interest payment, and debt reduction will continue at a constantly accelerating rate until the municipal debentures are all paid off.

The municipalities now have investments in Provincial and Dominion Government bonds aggregating $1,674,317.49 and cash amounting to $2,136,290.79, an improvement in these two items of $1,014,800.06 during the year.

Municipalities with quick assets of cash, securities, accounts receivable and inventories exceeding in value the accounts payable and debenture debt, are considered as out of debt and so listed in the annual report each year. The 1926 report will show 51 such municipalities as compared with 40 last year, and 21 more so nearly in that class that a fair proportion of them are expected to be transferred during the current year.

Taken in whole or in detail, it is hard to find anything in the 1926 report which is not gratifying.

Application of Hydro-Electric Power to Farm Work

Article No. 8.

THE Commission, in investigating the motor uses on farms where this power is metered separately, finds that the consumption for power purposes is small as compared with that for other services in many cases. This is not true, however, on the farm of Edward Harwood in the Woodstock Rural Power District. The service to this place is Class 3. There are two residences on this farm—that of the father and son, in addition to the other buildings which are shown in Fig. 1. The household uses, besides lighting, include the services of a washing machine for both places and an electric iron for each.

The installation is as follows:

Lighting 2 houses and buildings	1,660 watts
2 Irons	1,200 "
Washing Machine	186 "
3 h.p. motor	2,238 "
	5,284 watts

The net cost and consumption for year ending December 31, 1926, are submitted below:

Period Ending	Months	Consumption in kw-hr. Total	at 2nd Rate	Net Bill
March 31st	3	539	413	$23.04
June 30th	3	553	427	23.38
October 31st	4	341	172	23.92
December 31st	2	236	152	13.14
	12	1,669	1,164	$83.48

Fig. 1. Barns and Distributing Lines.

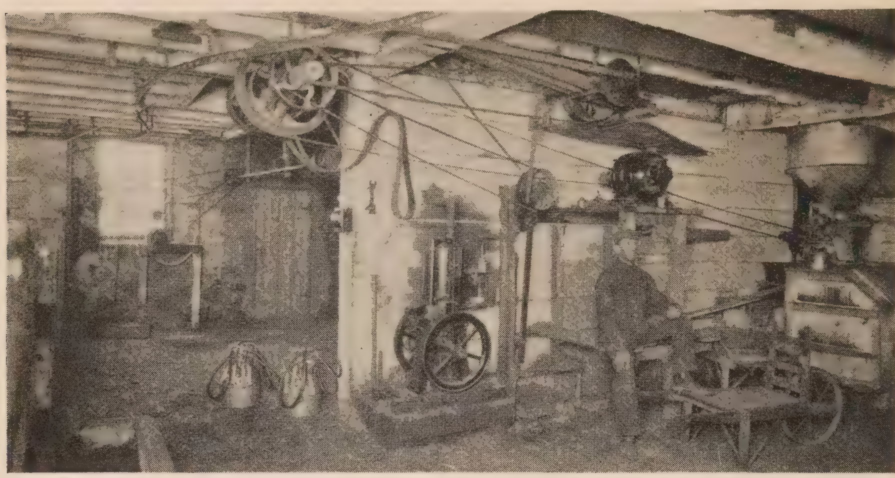


Fig. 2. Power installation in Barn. 3 h.p. motor and line shaft driving Chopper, Milking Machine, Grindstone, Emery wheel, Drill and Pump Jacks.

Mr. Harwood has within the last few days given us the following list of the work done by his motor:

Chopping—1,200 bushels of grain.

Milking—20 cows twice each day every day in the year.

Pumping water—For barn and dairy, including that of cooling milk. Water for the latter purpose is not all lost, some of it flowing to another tank for watering stock.

Cutting corn and feed—Corn in excess of that for ensilage is cut for feed as needed, no estimate of amount given, but would probably amount to 20 or 30 loads, or tons, last fall.

The motor run for all purposes amounted to three hours per day every day.

One corner of the barn has been used for machine shop purposes, as indicated in Fig. 2, a drill and grinder being installed at a convenient location where there is good light, besides another grinder not shown

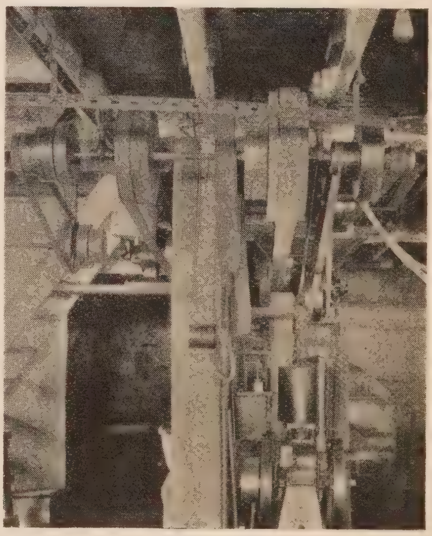


Fig 3. Another view of Motor and Line Shaft shown in Fig 2. The motor has superseded the gasoline engine.

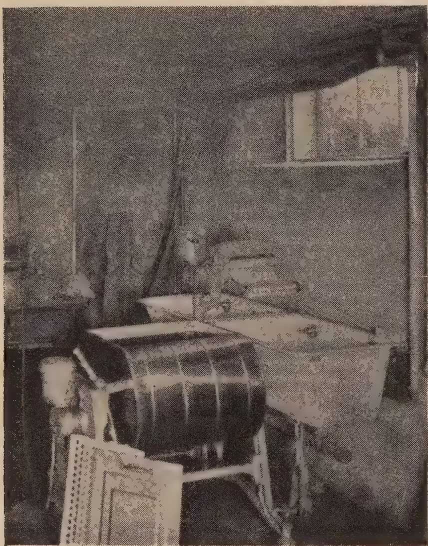


Fig. 4. Laundry.

which is erected on the top of the front of one of the mangers. This location was selected on account of the necessity for a free swing when sharpening mowing machine and reaper knives.

The power consumption as taken under this Class 3 service is by no means the maximum in the Province, but the uses are made most economically and he probably gets as great a value out of his expenditure for power purposes as any farmer in the Province. Careful study of his necessities and careful uses result in keeping his power consumption very low for the amount of work done, resulting to his own advantage very greatly, and he is unstinting in his praise of what Hydro Electric Power will do when properly applied to farm work.

Oil Circuit Breakers

By R. G. Matthews, Testing Engineer, Electrical Engineering Dept. H.E.P.C. of Ont.

IT is probable that every person who has used electric power in any form has at some time suffered inconvenience due to a blown fuse. The value of such a piece of apparatus has possibly been seriously questioned, particularly if the inconvenience developed into discomfort due to delay in replacing the fuse on the circuit which included the electric range. The fact is, however, that in such cases the fuse has functioned properly in its capacity as a protective device. It is accordingly an automatic circuit breaker of the most elementary form.

In handling large blocks of a.c. power and in controlling higher voltage circuits the oil circuit breaker performs the additional duty of a switch in disconnecting the circuit as well as of the fuse in affording automatic protection. Oil breakers can be obtained with various current and voltage ratings, with automatic or non-automatic control and are built for switchboard, wall, floor or cell mounting with electrical or manual operating equipment and for indoor or outdoor service.

In the evolution of protective devices the carbon circuit breaker

developed naturally from the switch, the carbon tips being introduced to take the arc in direct current circuits. As alternating current developed and higher voltages came into use longer arcs developed which were taken care of by switches with long arms equipped with fuses. When the fuses blew, the switch arm fell open and the radius of swing was sufficiently great to break the arc. It was discovered that with alternating current the introduction of oil between the contacts would quench the arc at the zero point of the wave. Hence the development of the oil circuit breaker, the chief advantage of which is the ability to confine all arcing to the interior of a tank full of insulating oil, thus reducing fire and life hazard.

The fundamental principle of the correct action of an oil breaker in opening a circuit under load is that the circuit should be broken at the instant the power flow is a minimum, at which time the voltage wave is passing through zero value. As the contacts separate, an arc is formed the size of which depends on the amount of current. The gap between the contacts fills with oil and a high resistance impedes the flow of current. The arc is interrupted as the voltage wave passes through zero but re-establishes itself at the high points of the wave until the contacts have moved so far apart that the intervening oil is sufficiently thick to resist puncture at the highest point of the wave. The heat of the arc volatilizes some of the oil and metal and a gas bubble is formed the size of which depends on the current flowing and on the duration of the arc. This bubble must be forced away from the contacts quickly enough so that the arc can be quenched during the time that the voltage wave is at the zero point. The speed with which this bubble is displaced depends on the relative specific gravity of the oil and bubble as well as the viscosity and head of oil in the tank. These gas bubbles give rise to great pressures which, under conditions of short circuit, often approach the force of an explosion.

In the design of a circuit breaker one of the main problems is to take care of these pressures. One manufacturer uses heavy cast steel explosion chambers around the contacts to take the initial high pressure. However, the tanks themselves are more often required to take the force of the explosion and in such cases they should be strongly constructed of material to successfully withstand these shocks. Attention must also be paid to the terminal insulation to see that it is securely fastened to the tank, since it must also withstand the same shock. In breakers developing high pressures it is usual to provide cylindrical or elliptical tanks with dome tops and bottoms. The tanks are not completely filled with oil but a space is left as a gas chamber in the top of the tanks above the oil level to provide a cushioning effect and so minimize the shock. These chambers are connected to the outer air through openings equipped with metal baffles or filled with pebbles to allow the gas to be expelled without loss of oil. These baffles also serve to cool the gas below ignition point so that it does

not burst into flame when it mixes with the outer oxygen. Sometimes, however, these gas chambers provide a convenient place for the accumulation of explosive mixtures which may be ignited by the arc, by compression or by a static spark. Tanks, therefore, must be rugged enough to take care of such occurrences.

Another important feature is the design of the contacts. Since the heat of the arc may blister the metal, contacts should be so shaped as to prevent arcing on the main current carrying surfaces. The forms vary with different styles of breakers but resolve themselves into three main types, the butt, finger and wedge, bayonet and ring. The butt type may be plain, in which two solid flat surfaces are pressed together. This type is acceptable for low currents, in which case the contact drop is small. The parts are easily renewable and if liberally proportioned, will quickly conduct the heat away from the contact. A variation of this type is introduced by one manufacturer in which the contact is made by pressing two spheres together. The other class of butt contact is the wound laminated brush contact similar to that used on carbon breakers. This type has very high current carrying capacity per unit surface and in addition has a very efficient wiping and self cleaning action. The spring action of the brush contact is great, and due to the heavy pressure which can be put upon it, the brush can be used very effectively in accelerating the opening of the breaker.

The finger and wedge contact is widely used for higher current carrying capacities. In this type the wedge is the moving element while the stationary conducting tips or fingers are supported in such a manner as to allow it to align itself automatically. This constitutes one of the advantages of the finger contact. Other advantages are the wiping action of the fingers on the wedge, the positive pressure of the finger springs and also the magnetic action of the current which tends to draw the fingers on opposite sides of the wedge together, since they are parallel conductors. Inspection is simple and renewals are easily made. This type can be used up to almost any current carrying capacity since all that is necessary is additional fingers and additional length of wedge.

Bayonet and ring type of contact is used on moderate currents. For heavy currents on breakers using this type the main carrying contacts are often laminated brush type, the bayonet being used as an arcing contact. This contact opens after the main contacts have separated and takes the arc away from them.

Auxiliary or arcing contacts are used on all but the lowest capacity breakers and may be of the wedge and finger, plain butt or bayonet type, as mentioned above. They should be placed in such relation to the main contacts that full advantage is taken of the magnetic blowout effect caused by the current passing down through the contact stud, across the moveable contact arm and up the other stud. This tends to blow the arc outward and should blow it off the outer edge of the arcing tip and also assist in

blowing the gas bubbles clear of the contacts outward and upward through the oil. Incidentally it is a wise provision to arrange the moving parts so that the action of gravity tends to open the breaker.

A third important item of design is the insulation which separates the current carrying parts from the tanks and also from each other. This includes the material of which the bushings are composed as well as that supporting the moving contacts. It should be permanent in composition, capable of withstanding a certain degree of heat, and of sufficient strength mechanically to withstand the sudden shocks incident to the operation of the breaker. Bushings should be so designed and installed that in the event of excessive voltage, they will flash over on the external portions rather than puncture or flash over on internal portions either of bushing or breaker.

The rating of an oil circuit breaker according to A.I.E.E. rules includes, among other items "the rated current interrupting capacity". This is defined as a rating "based upon the highest r.m.s. current, at normal voltage, the breaker can interrupt under the operating duty specified. The current value shall be that existing during the first half cycle of are between contacts during the copning stroke." This value will vary according to the length of time elapsing from the instant of short circuit until the breaker opens the circuit.

The current delivered by a generator is determined by the reactance of the stator, rotor and load circuits involved. When, however, a generator is short circuited the reactance of the load circuits is suddenly eliminated and the generator has to adjust itself to the new conditions. Due to electrical inertia the machine cannot do this immediately and a sudden rush of current results which is limited only by what is known as the "transient reactance" of the generator. This initial wave of current is many times greater than the steady short circuit current. In a three phase short circuit on a generator the current, in at least two phases, will always be unsymmetrical at the instant of short circuit. It rapidly decreases in value and becomes symmetrical in from 0.15 to 0.25 seconds, depending on the characteristics of the generator. The maximum current flow on the initial wave of short circuit occurs when the short circuit hits the line at the instant the voltage wave is passing through zero and its value will be approximately double the value of the symmetrical current and may vary from 5 to 20 times the mean full load current of the machine. Hence the speed with which a breaker acts determines the amount of current it will have to interrupt.

The factors which determined the rating of circuit breakers of the earlier types did not take into account this phenomenon. Ratings were based on what experience had indicated was safe for the generators then in use, but as the capacity of generators and plants increased it was found that the breaking capacity of the breakers was far too low to give the protection necessary. It was no uncommon occurrence at that time for tanks to be blown off

completely when a heavy short circuit was interrupted. Ratings therefore are now based, as noted above, on the highest r.m.s. current the breaker can interrupt.

In the choice of a breaker for a given location it is necessary, therefore, first to determine this current. The actual short circuit kv-a. that can be delivered by a generator or that can pass through a transformer bank is expressed thus:—

$$\text{Kv-a.}_{sc.} = \frac{\text{Rated Kv-a.}}{\text{\% Reactance}} \times 100 \qquad (1)$$

This equation is derived from the fundamental equation of the current which flows in a circuit of Voltage E and of Reactance X ohms. and which is expressed thus

$$I_{sc.} = \frac{E}{X} \qquad (2)$$

To show this let us take each item in equation (1) separately and analyze it.

$$\text{Kv-a.}_{sc.} = \text{Rated volts (E) x Short circuit current } (I_{sc.})$$
$$= E \times I \qquad (3)$$

$$\text{Rated Kv-a.} = \text{Rated volts (E) x Rated current (I)}$$
$$= E \times I \qquad (4)$$

% Reactance reactive drop (XI) in volts expressed as a percentage of rated volts (E)

$$= \frac{XI}{E} \times 100 \qquad (5)$$

Replacing the quantities in the original equation (1) with those obtained in (3), (4) and (5).

$$E \times I_{sc.} = \frac{(E \times I)}{\frac{XI \times 100}{E}} \times 100 \qquad (3) = \frac{(4)}{(5)}$$

Cancelling E from both sides of the equation and simplifying, we have

$$I_{sc.} = \frac{E}{X} \qquad (2)$$

as stated above.

As concrete examples are probably the simplest means of explanation, let us assume:

Two 8,000 kv-a., 3 phase 25 cycle 6,600 volt generators, No. 1 of 10 per cent. reactance, No. 2 of 15 per cent. reactance feed a bus section from which a 22,000 volt step-up transformer bank of 6,000 kv-a. capacity, and 5 per cent. reactance feeds out through a circuit breaker to a 3 phase feeder of 3/0 A.C.S.R. cable four miles long, wires 36 inches apart, to a step-down bank of 2,500 kv-a. capacity, 5 per cent.

reactance through a circuit breaker to a 2,300 volt bus with feeder breakers and feeders.

According to equation (1) above the short circuit kv-a. that can be developed by generator No. 1 will be

$$\frac{\text{Rated Kv-a.} \times 100}{\%\text{.reactance}} = \frac{8{,}000 \times 100}{10}$$

$$= 80{,}000$$

If the rated kv-a. had been 10,000 the equivalent reactance to obtain the same short circuit kv-a. would have been

$$10 \times \frac{10{,}000}{8{,}000} \text{ or } 12.5 \text{ per cent.}$$

Likewise for No. 2 generator we have

$$\text{Kv-a.}_{\text{s.c.}} = \frac{8{,}000 \times 100}{15} = 53{,}333$$

and the equivalent reactance based on 10,000 kv-a. would be

$$15 \times \frac{10{,}000}{8{,}000} = 18.75 \text{ per cent.}$$

If therefore a short circuit occurs on the bus, No. 1 generator will feed a short circuit kv-a. equivalent to that of a 10,000 kv-a. generator with 12.5 per cent. reactance and No. 2 generator an equivalent to 10,000 kv-a. with 18.75 per cent. reactance, or as found above $80{,}000 + 53{,}333 = 133{,}333$ kv-a.

This value may be obtained in another way. Since the equivalent reactances are based on 10,000 kv-a. rating we may say that we have the equivalent of a 10,000 kv-a. generator feeding a fault through two parallel reactances, one of which is 12.5 per cent. and one of 18.75 per cent. The combined reactance will therefore be the reciprocal of

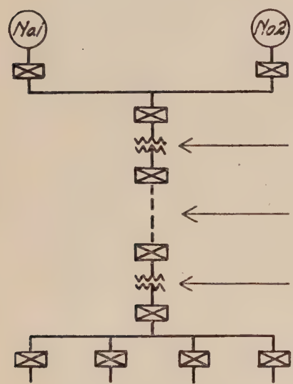
$$\frac{1}{12.5} + \frac{1}{18.75} = \frac{1}{7.5} = .1333$$

or 7.5 per cent. based on 10,000 kv-a. which gives a short circuit kv-a. of 133,333 as found above. Incidentally it may be noted that this value is obtained from the reciprocal simply by changing the decimal point which is the reason for basing the calculations on a basis of 10,000 kv-a.

Let us now solve three examples to illustrate, first, a method of obtaining the interrupting capacity necessary for a given location, and second, the effect a change of equipment may have on the amount of current a breaker may be called upon to interrupt. In these problems no account has been taken of the time required to open the circuit and hence the values would be considerably reduced for actual installations. The percentages, however, will not be altered and the conclusions drawn will therefore be correct.

We have already obtained values assuming a short circuit on the generator bus. We will therefore tabulate results assuming short circuits, first, at the generator bus, second, at the feeder side of the transformer bank, third, at the end of the feeder, and fourth, on a 2,300 volt feeder. We will also investigate the results of changing equipment, first, by increasing No. 1 bank to 7,500 kv-a. capacity, and 5 per cent. reactance, and second, by increasing No. 2 transformer bank to 6,000 kv-a. 5 per cent. reactance. The

table beside the sketch shows the values of kv-a. upon which the reactances are based for each example. 7,500 kv-a. transformers in place of 6,000 kv-a. and by the additional 4.8 per cent. by the installation of



Example		#1	#2	#3
	% Reactance	based on Kv-a.		
Generator #1	10	8000	8000	8000
Generator #2	15	8000	8000	8000
Transformer #1	5	6000	7500	7500
Line	4.18	10000	10000	10000
Transformers #2	5	2500	2500	6000

Example No. 1—Original problem. All reactances brought to 10,000 kv-a.

	Reactance	Total to Point	Kv-a.$_{sc.}$
Generators	7.5%	7.5%	133,333
Transformers No. 1	8.33	15.83	63,170
Line	4.18	20.01	50,000
Transformers No. 2	20.0	40.01	25,000

Example No. 2—No. 1 Bank of Transformers increased to 7,500 Kv-a.

Generators	7.5%	7.5%	133,333
Transformers No. 1	6.66	14.16	70,600
Line	4.18	18.34	54,500
Transformers No. 2	20.0	38.34	26,200

Example No. 3—No. 2 Bank of Transformers increased to 6,000 Kv-a.

Generators	7.5%	7.5%	133,333
Transformers No. 1	6.66	14.16	70,600
Line	4.18	18.34	54,500
Transformers No. 2	8.33	26.67	37,500

Thus we see that the short circuit kv-a. which the 2,300 volt feeder breaker would be called upon to interrupt in event of a short circuit is increased from 25,000 to 26,200, or increase from 2,500 to 6,000 kv-a. in No. 2 bank, the short circuit kv-a. is increased to 37,500 or 50 per cent. above the original amount. This is absolutely independent of the normal load which the transformers carry

The Function of an Illumination Service Department

By G. G. Cousins, Assistant Laboratory Engineer, H.E.P.C. of Ont.

SERVICE has become the king pin upon which the whole cycle of industry and commerce rotates. On the one hand industry has produced something which it wants to sell, knowing that the something produced can be of use and benefit to others in enabling them to better perform the various activities incidental to the daily routine of life.

The products of industry must give complete satisfaction to justify their existence, and industry is beginning to realize that its task is not ended with the sale of its product. Herein lies the field of service, to follow up the sale of the product, to correct faults that may develop, to suggest new applications or methods of use, and to see to it generally that the ultimate users of products obtain full value in usefulness for the money expended in buying what they need. Industry gets its reward and remuneration from the increased sale and use of what it has to offer provided that the commodity has established itself in the confidence of the users.

As to the application of this matter in our own business, we are engaged in generating and supplying power for many uses, a very important one of which is light. Light is a raw material of which illumination is the finished product. One of the very regrettable results of the purchase of light is that it very often does not get far from the raw state and the purchasers use raw material that serves them in a very unsatisfactory and often costly manner when they are to all intents and purposes paying for the finished product, illumination, which they do not receive.

When a person buys a machine or appliance of some sort he naturally expects to be guided in its use by its manufacturer or his agent, and this attitude is a real asset that manufacturers have taken hold of to maintain a close contact with the buying public. A similar situation exists on the part of power users of all classes toward the central station that supplies them with power. The central stations are particularly fortunate in respect to the closeness of their relationships to their customers because of the lack of competition from other electrical utilities in the same districts and because a continuous contact is maintained due to customers paying their bills at the offices of the company. Because of this, utility managers should be prepared to render as much assistance as possible in solving the electrical and lighting problems of their customers.

The need of a lighting service is so generally recognized that nearly all electrical utilities employ one or more men trained in the funda-

mentals of illumination. A similar service, limited in extent, has been rendered by the illumination section of the laboratories practically from the beginning of its organization although there has been no solicitation along this line. Information and lighting plans have been furnished at the request of Hydro utility managers as problems arose.

The operation of the illumination laboratory since 1912 has resulted in an accumulation of information and experience that is a necessary foundation for a successful illumination service department.

Our activities have been spread over a great variety of problems in the laboratory and outside, and the laboratory tests of luminaires of all kinds furnishes us with firsthand information on the characteristics of lighting devices.

Central stations under private ownership have found it possible to maintain their lighting service departments by the increased power consumption resulting from the installation of up-to-date lighting where poor lighting previously existed. These departments are manned by individuals trained in the fundamentals and modern methods of lighting. The revenue created by these departments is more than sufficient to justify their existence. On the other hand increased and properly planned lighting has more than paid for itself in increased output of industries, increased sales in stores and increased efficiency of office workers. The advantages of good lighting are many; in industry, increased output, decreased spoilage, better health and morale of the workers, fewer accidents and lower labor turnover; in commerce, increased sales due to the attracting and advertising power of light and the ease with which merchandise can be examined; in offices, better health due to decreased eye strain, greater speed of working and more cheerful atmosphere. There are many other fields concerned with recreation and activities not connected with the making of money where good lighting yields increased returns in the enjoyment of life or in the fulfilment of the purpose for which the lighting is installed.

Men generally are reluctant to spend money where money-making is involved unless they can see more money coming in as a result of the expenditure. A few courageous ones broke the trail into high intensity illumination and found that the new intensities actually yielded increased net returns. As a result of this, high illumination intensities are common to-day that were considered extravagant a few years ago and the trend is toward still higher intensities.

Obviously it is impracticable for each Hydro municipality to maintain a separate lighting service department, but since these municipalities collectively have, at their disposal, a laboratory that none of them could afford individually, it is possible for all of them to make use of the facilities of our laboratory in illuminating engineering as is being done in other branches of engineering, only in this case the service will be extended beyond the utility itself to its customers and will thus have a far wider application.

In offering the services of the illumination laboratory, attention is directed to the different position of the laboratory with respect to those for whom the service is intended as compared to the position of privately-owned utilities. The laboratory is not directly interested in applying this service as a load builder, it is purely a matter of engineering service. Our purpose is to render the best assistance possible to those desirous of improving their lighting conditions in any field of lighting regardless of whether a change will result in more or less power being used. Generally, improved lighting requires an increased power consumption as most of the places are under lighted at present. However, our purpose is to render service and any increase in load will be incidental.

We have been able to plan lighting systems from plans submitted in many cases; in others, visits to the premises have been made to investigate the conditions.

The laboratory is unhampered with any commercial affiliations and is consequently free to consider only the intrinsic merits of any lighting equipment that may be considered for a given purpose.

As to the need of improvement in lighting there can be no question. A well lighted factory or office is an exception, especially in the smaller places where there is less change in general conditions from year to year. Plant managers are blissfully (or woefully) ignorant of the value of a week's accumulation of minutes lost through inadequate lighting. A few seconds lost on each operation that is repeated several hundred times a day for each operator, amounts to a lot of money in a month. Some recent figures have just come to hand on the results of a study of time lost in a factory producing small automobile parts. Eight operations that were inadequately lighted were studied by means of a stop watch and a foot-candle meter. The total weekly loss per operator due to insufficient light ranged from $11.00 to $28.75. The initial cost of new equipment to correct the bad lighting ranged from $25.00 to $47.00 per operator, and the weekly cost of the lighting would range from $0.46 to $0.92. It is evident that the saving would in a few weeks pay for adequate lighting and would then be turned into dividends. This factory employed about 75 operators and is typical of thousands of others scattered all over the country. No man would think of whipping a horse to make him go faster when brakes were holding the wheels. With the brakes removed the horse could go faster without the expenditure of additional energy. Bad lighting is the brake that holds back production. Good lighting speeds up production without a conscious effort on the part of the workman. The industry benefits directly by such an increased production and the workman benefits indirectly by the lessened mental strain produced by an attempt to see with insufficient light. The writer has seen enough of the conditions in various places to indicate that there is a great deal to be done. The managers of the local utilities are familiar with the conditions in their own districts and are most favorably situated to locate

prospects if they wish to extend this service aggressively.

This lighting engineering service is offered as an adjunct to the lamp testing service that has been carried on since the beginning of the laboratory. The Commission has a completely equipped illumination laboratory for studies and tests in all branches of illumination. Illumination surveys of lighting installations of all kinds, interior or exterior, can be made as well as laboratory tests of lighting units and accessories.

In the past a considerable amount of testing of a commercial nature has been done and the facilities of the laboratory are still available for this class of work.

There is great opportunity for the Commission through the local utilities to raise the standard of lighting throughout the Province and to assist in solving the troublesome lighting problems encountered in so many industries, stores and offices. It is hoped that the utility managers will be alive to the opportunities to be of service that are at hand and will make use of the facilities of the laboratories in promoting the cause of good lighting.

The Statiphone, a Device for Testing Pin-Type Insulators

THE "statiphone" is the official name given to a device developed by our laboratory staff, in co-operation with the Operating Department, for testing the electrical condition of pin-type porcelain insulators while the lines are alive. The voltages at which testing is being done range from 12,000 to 66,000 volts.

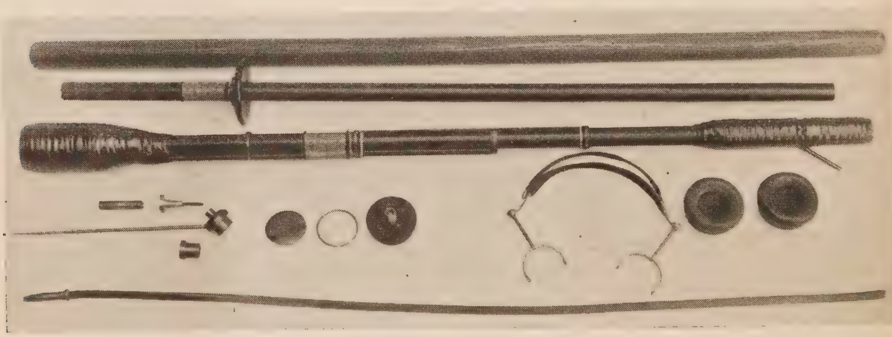
The number of insulators of this type and voltage range required by the Commission to maintain its feeders, is approximately half a million, and since the failure of one insulator may be sufficient to cause an interruption on that feeder, it will be apparent why a reliable method of testing their condition would be very valuable. All known methods of testing insulators had been carefully studied and the results checked by various members of the engineering staff and it was felt that no method available was sufficiently reliable to give the desired degree of confidence. Consequently our laboratories were requested to proceed with such a series of tests as would lead to the development of a satisfactory scheme for testing pin-type insulators on live lines and this work was commenced early in 1923. Fortunately the patent situation in Canada was such that considerable freedom could be exercised as to ways and means of accomplishing any desired result and this proved of considerable advantage.

A study of the electrostatic field around a porcelain insulator of two or three sections is necessary for a proper understanding of why and

Statiphone Assembly.

how the statiphone operates. The division of voltage between sections depends on the electrostatic capacities of the sections and hence adjustments made for one type of insulator may not be correct for another type, even of the same voltage rating. The function of the statiphone is to determine the potential at which any particular point on the insulator, e.g., the cemented joint, is operating, while in service, and this is the limiting feature of the statiphone. If for any reason a faulty insulator should give the same potential as a good insulator it would be indicated as good but in practice this probability is very slight.

Preliminary tests showed that some devices, such as the Geissler tube, were too sensitive and could not be adapted easily to indicate small differences with sufficient clarity. Other devices consuming too much power would disturb the normal potential distribution past any practical value, as the amount of energy is very limited. It was obviously desirable to use the properties of the insulator as it existed combined with ordinary line frequency of voltage as simply as possible, rather than to superimpose any high frequency or impulse voltages on the unit. The latter method might appear to have some advantages but it also introduced variables which might increase the percentage of errors in final test. The receiver of an ordinary telephone coil was connected between two points, one on the insulator, the other in space about two feet from the insulator, but the sound being of low frequency and low amplitude was unsatisfactory. Then a spark gap was connected in series to break



Details of Statiphone.

the peak of the voltage wave into impulses of higher frequency; the result was beneficial but not good enough.

Other experiments were made which indicated that we could make efficient use of the electrostatic forces existing between opposite plates of an air-condenser which force would vary as the square of the voltage applied and therefore be very effective. In the final construction one of these plates is stiff and fixed, the other, of thin stiff metal, free to vibrate and backed by a sound-chamber, somewhat similar to that of an ordinary ear-piece but provided with a long tube, similar to an ordinary speaking tube. The addition of an adjustable spark-gap between the fixed plate of the condenser and the tip-terminal of the instrument provides means whereby the voltage-wave might be disturbed at its peak value and be made to give more audible sounds. This assembly was, by a few trials, made to give very good results but still was not quite perfect, and the next step was to add an adjustable terminal which could be carried out into space and by exposing the condenser to higher differences in voltage, obtain greater power and at the same time greater sensitivity in adjustment.

Field tests made at this stage of development gave very encouraging results. Two hundred and nineteen 13,000 volt insulators were tested, of which forty-five were shown to be bad. Twenty-nine could be detected as faulty by close visual inspection, thirteen more were shown to be faulty by the megger and flashover tests, and only three stood the latter tests, in the laboratory. Subsequent field experience seemed to discredit these results but it was found that an insufficient amount of attention had been given to a number of points which affect the results, viz., variations due to the type of insulator, the amount of moisture on the surface as far as it affects potential distribution on the insulator; whether the pin is grounded or separated from ground by a dry cross-arm having an insulation resistance of thousands of megohms. Better results are being obtained, however, by men with some experience at the work and who appreciate how many variables there are to contend with but no recent figures are available as to the per cent accuracy that has been obtained with this instrument.

Association of Municipal Electrical Utilities

Minutes of Meeting of Executive Committee.

A meeting of the Executive Committee was held at the office of the Hydro-Electric Power Commission on Monday, April 4th. The meeting was called to order at 2.15 p.m. by Mr. J. J. Heeg, President; other members of the Executive Committee present being Messrs. J. G. Archibald, R. J. Smith, E. J. Stapleton, O. H. Scott, D. J. McAuley, J. G. Jackson, C. T. Barnes, V. S. McIntyre, and S. R. A. Clement.

It was moved by Mr. R. J. Smith and seconded by Mr. E. J. Stapleton that the Minutes of the last Execu-

tive Committee meeting be taken as read.—CARRIED.

This meeting was called for the purpose of considering plans for the Convention of this Association, to be held jointly with the Ontario Municipal Electrical Association, at the Clifton Hotel, Niagara Falls, on June 23rd, 24th and 25th, 1927.

Mr. W. R. Catton, Chairman of the Papers Committee, being unable to attend, mailed in his suggestions for papers to be given at the Convention. In that it was proposed to hold three business sessions, the same being held during the forenoon of Thursday, Friday and Saturday, it was thought advisable that two papers be obtained for each morning. Based on the suggestions submitted by Mr. Catton, the following program was approved on the motion of Mr. O. H. Scott and seconded by Mr. V. S. McIntyre:

THURSDAY—June 23rd.

1. Grounding.
2. Demand Meters.

FRIDAY—June 24th.

1. (a) Hydro Act Revision.
   (b) Contract as applying to Hydro Utilities.—By Mr. W. G. Hanna.
2. Joint Session with O.M.E.A.

SATURDAY—June 25th.

1. Accident Prevention.
2. A paper on "Merchandising".

Mr. J. G. Archibald presented a report of the Convention Committee, giving suggestions for entertainment during the Convention, and asked for approval of the following appropriations in connection with the same to be shared with the O.M.E.A.

(1) Orchestra for two luncheons, convention dinner and dance—$100.00.

(2) Prizes for contests—$200.00.

(3) For entertainment of ladies—$50.00.

In presenting his report, Mr. Archibald moved its adoption, which, on being seconded by Mr. Stapleton, was carried.

Mr. V. S. McIntyre reported progress in the Rates Committee and also in the Committee on the Pension Scheme. A report concerning the latter would be submitted at the Convention.

Mr. J. G. Jackson made a suggestion regarding battery chargers, and asked that the same be taken up by the Regulations and Standards Committee.

Mr. McAuley made a report regarding the finances of the Association.

There being no further business, the meeting adjourned at 3.45 p.m.

Men's Bowling League

The annual banquet and presentation of prizes of the Men's Bowling Club of the Hydro-Electric Power Commission was held at the Prince George Hotel on the evening of April 4th. This event marked the closing of a very successful season, and the bowlers are to be congratulated on the fact that not a single default occurred during the whole series, which is very unusual in most leagues of this size. The interest and competition were keen throughout and the first place was within

reach of several teams until almost the close of the season.

Unfortunately, none of the Commissioners were able to be with us; but they were ably represented by three men who, almost without fail, are present at this annual event; namely, Mr. Gaby, Mr. Pope and Mr. Lucas. These men have always given their whole-hearted support to the Bowling Club, and we would have been disappointed indeed had they not been there.

Mr. Gaby gave a very interesting talk on the present activities of the Hydro, while Mr. Pope and Mr. Lucas touched on the early trials and tribulations of the Hydro in its struggle for existence some twenty years ago.

Mr. Simpson and Mr. Carl, President and Secretary respectively, of the Canadian Bowling Association, gave short but interesting talks on the aims and objects of their Association, and brought out clearly that the Canadian Bowling Association is deserving of the loyal support of all those interested in 5-pin bowling. The Committee take this opportunity of thanking these two men for being present on this occasion.

Mr. Gaby then toasted the Hockey Team, giving a short review of their fine showing in the Industrial League. This toast was replied to by their Manager, Mr. Bain.

The presentation of the prizes by Mr. Gaby was then proceeded with. The first prize in the 5-men team event was won by the Accounts Payable Team, captained by Mr. Jack Gourlie. Sufficient space in this article is not available to give the names of prize winners other than the first team, although there are several teams and individuals worthy of honorable mention.

The election of officers next took place, and the following men form the committee for the season 1927-28:—

President—A. V. Cassidy,
Vice-President—G. O. Vogan,
Secretary—J. F. Whitehead,
Treasurer—P. G. Weir,
Committee man—W. H. Fawcett.

The banquet was over about 8.30, and most of those present adjourned to the bowling alley and participated in a doubles tournament, which was won by Mr. W. McKenzie and Mr. R. Beaton.

It would not be fitting to close without thanking the members of the Bowling Club on behalf of the Committee for their support and co-operation during the past year. The Committee did their best, but their best would have been poor indeed without the support of all the bowlers.

Production of paints, pigments and varnishes in Canada, according to the Dominion Bureau of Statistics, amounted in value to $22,234,268 in 1925, an increase of 9 per cent. over the output value of $20,200,824 in 1924.—*Natural Resources, Canada.*

Hydro News Items

Central Ontario District

The City of Peterborough is gradually improving the old Street Lighting System and the results obtained are remarkable. In the business section, the old Magnetite Arcs have been replaced by 1,000-watt Incandescent fixtures. In the residential sections, 60-watt Multiple Units are giving way to 300-watt units in a Luxolite pendant with Holophane Refractors. When all changes are complete, Peterborough should be one of the best lighted cities on the continent.

* * * *

Commission approval has been obtained for the construction of 6.2 miles of rural line from Port Hope to Welcome and Canton.

* * * *

Applications have been received for rural service from several residents of Hallowell Township in the Wellington Rural Power District.

* * * *

Georgian Bay System

A third single-phase transformer was added to the Waubaushene municipal station early in March, increasing the capacity from 50 to 75 kv-a. in order to take care of an additional 30 h.p. load in the stave mill.

* * * *

Niagara District

Arrangements are being made by the Commission for the establishment of a field office in Chatham in connection with the operation of the Chatham and Wallaceburg Rural Power Districts. These districts have been operated for the Commission by the local municipalities, but have now grown to such proportions that a field superintendent is necessary.

* * * *

A field superintendent has recently been installed, with an office in Ridgetown, to take care of the Ridgetown Rural Power District. The local system in Ridgetown will also be taken care of by the same superintendent.

3-250 kv-a., single phase, outdoor type, 26,400/4,000 volt transformers are being installed at Ridgetown to replace 3-150 kv-a. units.

* * * *

Plans are being prepared for increasing the transformer capacity of the Preston and St. Mary's Transformer Stations to take care of the growth of load.

* * * *

The Windsor Hydro-Electric System will put into service very soon a new substation, which is of the semi-outdoor type. The equipment is being tested out at the present time.

* * * *

A second, 1,500 kv-a., outdoor type, 26,400/4,000 volt transformer is being installed at the Riverside substation near Walkerville.

* * * *

A 3,000 kv-a., three-phase, outdoor type transformer is being installed at Sandwich distributing station; this unit replaces the 1-1,500 kv-a. unit now at this station.

* * * *

The capacity of the distributing stations at Forest and Dresden is being increased, the 3-75 kv-a., single-phase units being replaced in each station by 3-150 kv-a. units.

* * * *

St. Lawrence System

The Town of Vankleek Hill, Prescott County, is negotiating for a supply of electricity.

* * * *

Rural residents east of Chesterville and west of Morewood, in Winchester Township, have made application for rural service.

* * * *

Residents of the Police Village of Crysler are negotiating for rural service in conjunction with rural residents of Finch and Winchester Townships.

Ladies' Bowling League

The ladies of the O.H.E.C. Bowling League closed the season's activities with the customary annual banquet which was held in the Yellow Room of the King Edward Hotel on the evening of March 14th, a goodly number being present.

The Executive were pleased to welcome as guests of the evening Mr. and Mrs. F. A. Gaby, Mr. W. W. Pope and Mrs. Macaulay Pope, who kindly consented to present the prizes to the successful contestants.

Mr. Gaby and Mr. Pope delivered appropriate addresses, and community singing was indulged in by all present. The election of officers for 1927-1928 resulted as follows:—

President—Miss Mabel Evans,
Vice-President—Miss Sheppard,
Secretary—Miss Craddock,
Treasurer—Miss D. Cumming.

The retiring Executive was:—

President—Miss R. Holt,
Vice-President—Miss B. Fletcher,
Secretary—Miss I. M. Sumberg,
Treasurer—Miss Garvey.

Dancing and cards brought to a close an enjoyable evening's entertainment, music being furnished by the members of the Hydro orchestra, to whom grateful acknowledgement is hereby made.

Congratulations are due to Mr. Ivan N. Pritchard, Accountant, Public Utilities Commission, Chatham, Ont., and Mrs. Pritchard, to whom there arrived on March 10th a young son weighing 10 pounds. John Edward is a husky boy.

At a meeting of the Electric Club of Toronto on March 23, Mr. T. R. C. Flint, District Manager, Toronto Hydro-Electric System, and a former employee of this Commission, was elected to the office of President of the Club for the ensuing year 1927-1928. We wish to take this opportunity of congratulating Mr. Flint on his election and extend

to him our best wishes for his term of office.

At the annual meeting of the Toronto Branch, Engineering Institute of Canada, held on March 24, 1927, the following engineers on the staff of the Commission were elected to offices of the Branch:

Mr. Roderick B. Young, Senior Assistant Laboratory Engineer, was elected Chairman of the Branch for the ensuing year 1927-1928.

Mr. J. A. Knight, Hydraulic Dept., was elected Vice-President.

Mr. J. J. Trail, Engineer of Tests, Hydraulic Department, was elected to the Executive Committee for a period of two years.

Mr. J. W. Falkner, Transmission Section, Electrical Engineering Department, was the retiring Secretary-Treasurer.

The Tail of a Kite

The current number of the *Winnipeg Hydro News* gives the story of an accident that happened to their lines on March 5th. Although no material or personal damage was done, yet there was the inconvenience of a 2½ minute interruption, and at the same time the possibility of serious injury under similar circumstances.

As usual it was just a little thing that caused the trouble, and in this case it was the tail of a kite. Some young disciple of Benjamin Franklin had been flying his kite until it had wound itself snugly around the lower cable of one of the Hydro transmission lines and hung there. The wind blew the wet string across the tower, and then—the fireworks started!

There are two circuits on a tower line, one on each side. When the kite-tail blew against the tower that circuit was grounded and was automatically shut down by means of relays. The wind carried the arc across the tower to the lower cable on the other circuit, a distance of eleven feet horizontally and then up seven feet to the second cable. You will get a better idea of the size of this gigantic spark when told that it was visible, in broad daylight, for a distance of over a mile.

Kite flying is a popular form of amusement, but parents would do well to warn their children not to fly kites near lines carrying electric power. Not only is inconvenience caused consumers on account of interruption of service—as in the case given above—but there might be real danger to the child flying the kite.

If the boy climbs the pole to free his kite from power lines he may come in contact with live wires and be severely burned or knocked to the ground. Fly your kites, boys and girls, but keep them away from the wires.

SUMMER CONVENTION
O.M.E.A and A.M.E.U.
at
Niagara Falls, Ont.
June 23, 24 and 25, 1927

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in March, 1927.

Appliances

THE ACME ELECTRIC AND MANUFACTURING COMPANY, 1444 Hamilton Ave., Cleveland, Ohio.

Hot Cathode Argon Gas Filled Rectifier. "A" battery trickler charger. "A" and "B" battery charger, 60 cycles.

Radio Appliances. "B" Power Supply, Model 30, 60 cycles. Automatic Contactor Control.

Marking: Nameplate with manufacturers' name and the ratings of primary and secondary.

* * * *

BEATTY BROS. LIMITED, Fergus, Ont.

"The Beatty" Washing Machine.

* * * *

BELLEVILLE ELECTRIC AND STAMPINGS LIMITED, 100 Church St., Belleville, Ont.

Portable Electric Hotplates.

Portable Electric Toaster.

Marking: "G.M.S." and the rating in volts and amperes.

* * * *

S. F. BOWSER COMPANY, LIMITED, 52-68 Fraser Avenue, Toronto.

"S. F. Bowser." Electrically-illuminated Oil Display Stands. Gasolene Pumps, Nos. 113 and 114.

* * * *

CANADIAN GENERAL ELECTRIC COMPANY LIMITED, 224 Wallace Ave., Toronto.

Telechrons, Nos. 322, 331 and 405.

CANADIAN PNEUMATIC TOOL CO. LIMITED, 25-27 St. Antoine St., Montreal, Que.

CHICAGO PNEUMATIC TOOL CO. (Mfr.), 1241 E. 49th St., Cleveland, Ohio.

"Hicycle" Portable Electric Drills and Grinders.

* * * *

THE COLEMAN LAMP CO. LIMITED, 9 Davies Ave., Toronto.

Electrical Equipment for Oil-Burning Furnace.

* * * *

M. A. CUMING CO. LIMITED, 28 Mercer St., Toronto.

Portable Hat-Blocking Device.

* * * *

DINEEN STAGE EQUIPMENT, 30 Mutual St., Toronto.

Spotlight for use in theatres.

* * * *

THE FEDERAL COMBUSTION CORPORATION, LIMITED, 15 Ontario St., Stratford, Ont.

Electrical Equipment for Oil Burners.

* * * *

FINDLAY BROS. CO. LIMITED, Carleton Place, Ont.

"Findlay" Cabinet Type Electric Cooking Range. Style Nos. H40S, H40E, H30S and H30E.

* * * *

WM. GURD & CO., 185 Dundas St., London, Ont.

Radio "B" Battery Eliminators. "Wm. Gurd & Co." 25 cycles.

Ice-o-matic Refrigeration Co. Ltd., Windsor, Ont.

Electric Refrigerators.

* * * *

The F. E. Myers & Bro. Co., Ashland, Ohio.

Myers Motor-Operated Shallow Well Pumping Outfit.

* * * *

Northern Electric Company Limited (Submittor), 131 Simcoe St., Toronto.

M. S. Wright Co. (Mfr.), Worcester, Mass.

Portable Vacuum Cleaners "Graybar".

* * * *

Ontario Wind Engine & Pump Co. Limited, Atlantic Avenue, Toronto.

Automatic Motor-Operated Shallow Well Pumping Outfit. Type D.A.

* * * *

The Peerless Electric Company, Weston, Ont.

Automobile Electric Heater. "Peerless."

* * * *

The Premier Vacuum Cleaner Co. Limited, 233 Richmond St. W., Toronto.

Portable Vacuum Cleaner. "Eatonia."

* * * *

Sheet Metal Products of Canada Ltd., 199 River St., Toronto.

Electrically-Heated Clothes Dryer.

* * * *

Universal Cooler Co. of Canada, Limited, Howard Avenue, Windsor, Ont.

Automatic Electric Refrigerator.

* * * *

Webster Motors Limited, 56 Wellington St. South, Sherbrooke, Quebec.

"Webster" Automatic Electric Control for Garage Doors.

* * * *

*Electric Water Sterilizer & Ozone Co. Scottdale, Pa.

Water Sterilizer, Cat. Nos. 0 to 4 incl.

Automatic Water Sterilizing Apparatus.

Automatic Air Sterilizing Apparatus.

* * * *

*Fitzgerald Mfg. Co. The, Mfr., Winsted, Conn.

Electric Flat Iron, Cat. No. 701.

Marking: Manufacturer's name and catalogue number.

* * * *

Switches

Square D Company Canada Limited, Walkerville, Ont.

With shutters only, double-throw solid neutral enclosed switch with interlocking mechanism. Cat. No. 6512.

* * * *

*Penn Electric Machine Co., Des Moines, Iowa.

Automatic Switches, Pressure-operated Type (As listed on Underwriters' Laboratories card dated December 17, 1926).

Automatic Switch—Float Type (As listed on Underwriters' Laboratories card dated December 17, 1926).

* * * *

*Smart-Turner Machine Co., The. Ltd., Hamilton, Ont.

Automatic Switch—Float Type.

* * * *

Fittings

THE DUNCAN ELECTRICAL COMPANY LIMITED, 2 Inspector St., Montreal, Que.

Medium Base Receptacles, Concealed Type, Cat. No. 2747.

Porcelain Rosette, Concealed Type Cat. No. 2694.

* * * *

KIRKWOOD MANUFACTURING CO. LIMITED, Preston, Ont.

Flush Device Boxes, rigid conduit pattern. Cat. Nos. 100, 170, 3000.

Outlet Boxes, sheet steel. Cat. Nos. 1900, 1915, 6350, 6350D, 6250, 18L, 7000, 7100. Cast iron, Types FS, FSC, G, H, HA, J, K, P, PC, PL, PT, PM, PMC, PML, PMT, S, SC, V, VA, VC, VL, VT, VH, VHA, VHC, VHL, VHT, W, WC, WL, WT.

Cast-iron Conduit Fittings, Types A, B, C, D, DF, E, F, FB, LB, LBA, LBV, LF, LL, LR, T, TB, TL, TR.

Steel Covers for Conduit Fittings.

Marking: "K" in a diamond moulded in the metal.

* * * *

*EAGLE ELECTRIC MFG. CO., 59-79 Hall St., Brooklyn, N.Y.

Receptacles for attachment plugs, single and duplex type, Cat. Nos. 125, 130.

"Eagle."

* * * *

Portable Lighting Devices

CASSIDY'S LIMITED, 20-22 Front St. W., Toronto.

Portable Electric Lamps. "Cassidy's Limited, Toronto."

* * * *

M. LEBOF, 121 Lisgar St., Toronto.

Portable Electric Lamps. "M.L."

* * * *

WILLIAM R. NOE & SONS, 43-47 East 10th St., New York, N.Y.

Portable Electric Lamps. "N."

* * * *

Miscellaneous

LEE SKIPWITH & CO. INC., 50 Church St., New York, N.Y.

Porcelain Split Knobs, No. 5-½. "S enclosed in a square."

* * * *

*BOURN MFG. CO., S. W., 248 Harrison St., Providence, R.I.

Armored Cable.

Marking: Letter "B" stamped in armor at intervals of about two inches, or three parallel black threads woven in outer braid, or one yellow thread between outer braid and armor, a fibre tape, marked S.W. Bourn Mfg. Co., between outer braid and armor.

* * * *

*HARRIS MFG. CO., THE J., Whitby, Ont.

Flexible Tubing.

Marking: Two parallel green threads woven longitudinally and appearing dotted on the inside of the tubing.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

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Summer Convention

As intimated in previous numbers of THE BULLETIN, the Summer Convention of the Ontario Municipal Electrical Association and the Association of Municipal Electrical Utilities will be held at the Clifton Hotel, Niagara Falls, Ontario, on June 23, 24 and 25. The committees in charge of the convention arrangements are sparing no effort to make the convention the success which the co-operation and attendance of the members will give it.

The programme of the business sessions has been laid out as follows, *all of which will be taken care of in the mornings:*

Thursday, June 23rd:

Business meeting A.M.E.U.

Paper, "Grounding," by E. M. Wood, Electrical Engineering Department, H.E.P.C. of Ontario.

Paper, "Power Billing Based on Demand," by H. D. Rothwell, Municipal Dept., H.E.P.C. of Ontario.

Friday, June 24th:

Paper, "Accident Prevention," by Wills Maclachlan, Employees' Relations Department, H.E.P.C. of Ontario.

Paper, "Opportunities and Duties of Electrical Utilities," by A. K. Baylor, General Electric Company, New York.

Saturday, June 25th:

Paper: (a) "Hydro Act Revision"; (b) "Contract as Applying to Hydro Utilities," by W. G. Hanna, Legal Dept., H.E.P.C. of Ontario.

Joint session O.M.E.A. and A.M.E.U. when the Pension Scheme will be explained and discussed.

It is seen by the foregoing that a variation has been made in the usual

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procedure of holding these conventions. Business sessions are to be held in the mornings only, while the remainder of the day is left for entertainment and amusements, following the plan adopted by some of the larger organizations for their summer meetings. This has been done with an important object and the hearty co-operation of the delegates must be given to assure its success. It has been recognized in the past that the Summer Convention should combine a reasonable amount of pleasure with the more serious parts of its work, yet if the convention is to be of any value to the utilities, the delegates must attend all the business meetings and take part in the discussions. It is for this reason that the programme has been so arranged, and we feel sure that everyone attending will fall in with the plan and make of the convention what is intended, knowing that he is enabled to enter into all of the real business of the convention and yet have ample time for recreation and enjoyment of the short holiday.

Delegates! come to the convention prepared to benefit by it both as to your work and as to pleasure. Be on time at the opening of all business sessions so that they may be opened promptly and finished before noon. Also be prompt at the convention dinner and luncheons so that these too may be held within the time allotted to them. The committees and contributors to the programme are working hard to make the convention a success. In all fairness to them do your part by a faithful attendance and taking a whole-hearted interest in all of the proceedings.

Application of Hydro-Electric Power to Farm Work

Article No. 9

IN the 1918 rural extensions a line was built to farms west of Sunderland. Included in this group was the home farm of Philip Rynard. The old form of contract in use at that time was for two horsepower, with an excess rate for all power taken over that amount. Excess demand meters were not available owing to the war, and all current taken was charged for at the first rate, as the total uses were within the 60 hours' use of contract amount per month, the standard at that time.

In the readjustment of classifications when this section was taken into the Cannington Rural Power District, this became a Class 6B service, as three-phase service for a 7½ horsepower motor was demanded.

The details given below are based on the 1926 rates for this class:

Service Charge—$6.45 per month.

Consumption Rates—6c for the first 126 kw-hr. used in each month. 2c for the remaining consumption. 10% discount for prompt payment.

The installation as at November 1, 1926, was:

Lighting in the house...	990	watts
" " " barn and other buildings.......	400	"
Electric range..........	7700	"
Washing machine......	186	"
Electric iron...........	600	"
Toaster...............	600	"
Vacuum cleaner........	80	"
Curling iron heater.....	25	"
7½ horsepower motor...	5600	"
½ horsepower motor on cream separator......	372	"
Total.........	16553	"

This being a 200-acre farm started 100 years ago, the buildings are large. The house is 60 ft. by 32 ft. with cellar under all of it and a second floor the full size. The main portion of the barn is 60 ft. by 110 ft. with an L 34 ft. by 72 ft. The stables have capacity for 100 head of cattle and horses, and pens for 100 pigs.

Mr. Rynard believes in having ample power for all of his work; besides farm horses he has a tractor for

Fig. 1. House and Barns of Philip Rynard, Sunderland.

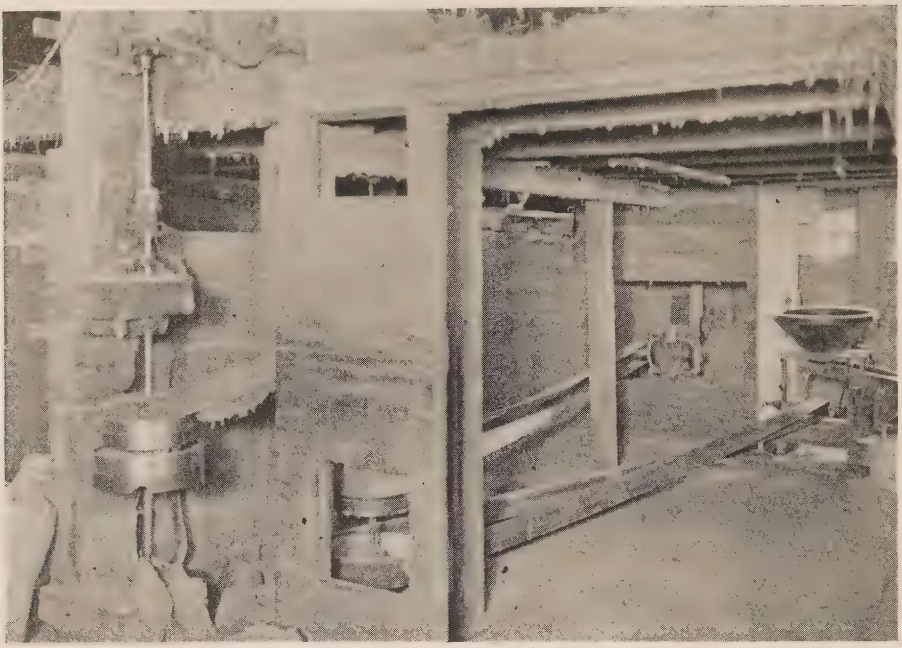


Fig. 2. 7.5 h.p. motor driving vertical shafts, 9.5 in. chopper and pump jack.

field work. These with the equipment of this place are used on his other farm some distance away. The 7½ horsepower motor is belted to a perpendicular line shaft, as shown in Fig. 2, formerly used with his power windmill. A secondary line shaft, also perpendicular, delivers power to a pump jack and root pulper. The chopper is belted to the primary line shaft.

The following farm machinery is driven by this motor at the speeds noted:

9½ in chopper–at 2240 rev. per min.

Pump through jack and jerk rod (well 50 ft. deep)—40 strokes per min.

Hamilton cutting box—246 rev. per min.

Root pulper—154 rev. per min.

Fig. 3. Brooder using a 100 watt lamp.

A half-horsepower motor is used in the dairy to drive the cream separator.

The work done during the last year by the equipment on this place is given as:

In the barn

Chopping—3,000 bushels of grain.

Cutting straw—20 tons.

Pumping water for 100 pigs, 70 cattle and 8 horses.

Pulping—1,000 bushels of turnips.

Separating cream—About 15 minutes each time, twice each day.

In the house

Electric range—Used all the year (family of five), extra help at times.

Washing machine—An average of four hours per week.

Electric iron—An average of five hours per week.

Toaster—Occasionally.

Vacuum cleaner—Occasionally.

Curling iron heater—Occasionally.

Two 100-watt lamps—As a brooder for mothering chickens, sometimes one only used for about six weeks.

The consumption of power and net cost for the year ending April 30th, 1927, by periods were:

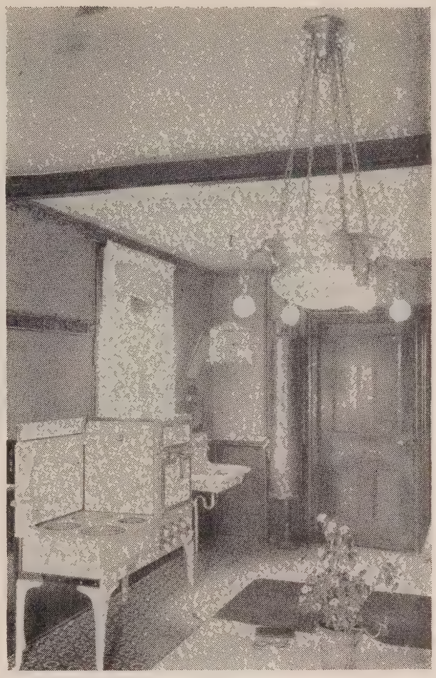


Fig. 4. Kitchen installation.

kw-hr. The growth in uses on this place has, therefore, been for domestic and lighting purposes mostly. The range was installed in the spring of 1925.

For	Total	Consumption Kw-Hr. For Power	At 2nd Rate	Nett Bill
3 months ending July 31.......	1262	287	884	$53.74
3 " " Oct. 31.......	1984	158	1606	61.34
3 " " Jan. 31.......	1558	411	1180	59.07
3 " " Apr. 30.......	1269	430	891	53.87
	6073	1286	4561	$228.02

In 1920 the consumption was 2165 kw-hr. and the net annual bill $196.49 under the old contract; in 1926 nearly three times the consumption cost $228.02; the uses for power in 1920 was 1219 kw-hr. and in 1926, 1286

Mr. Rynard gets quite enthusiastic when discussing his electric service, believing every farmer can make it pay and add the convenience and satisfaction of safe and good lighting in house, barn and other buildings.

How Toronto Hydro Stations are Built and Maintained

By J. B. Kitchen, Engineer in Charge, Station Construction Dept., Toronto Hydro-Electric System

THE duties allocated to the Station Construction Department consist of erecting station buildings, equipping them with the necessary apparatus and maintaining buildings and apparatus after they are in service.

To carry out this work most efficiently, the department is divided into sections consisting of: Executive, electrical design and drafting, architectural drafting, station construction, maintenance and machine shop.

New work in this department follows a very definite and standardized routine. Layout drawings in sketch form are made for approval. From these working drawings of buildings and equipment are prepared and checked. Estimates are then prepared giving the cost of such work as is involved and allocating to the different accounts their proper proportions of the work. When these estimates are approved by the Chief Engineer and General Manager, work orders are issued by the General Manager's office and the construction staff proceeds with the actual installation of apparatus and equipment. After the job has been finished it is inspected and then turned over to the Operating Department. The apparatus is automatically placed on the inspection schedule of the maintenance section which inspects all equipment regularly and in accordance with an approved schedule.

We have on the system, all told, thirty-eight stations, large and small. There are three terminal stations, fourteen major substations, five intermediate substations, the remainder being smaller and of less importance. These stations represent a total value on the books of the Hydro of $11,315,342.34, divided up between buildings and equipment; the buildings are valued at $2,310,139.82, and the equipment $9,005,202.52. Housed in the above buildings is the necessary equipment required to reduce the voltage for commercial use, such as transformers, regulators, oil switches, switchboards and so forth.

It might be interesting to give some figures, enumerating some of the more important apparatus. There are 378 commercial and power transformers ranging from 150 kv-a. to 5,000 kv-a., giving the total transformer capacity of the Toronto Hydro-Electric System as 249,140 kv-a. There are 239 automatic regulators which are connected two, on 2200 volt, 3 phase feeders and three on 4150 volt 3 phase feeders. There are 39 synchronous converters and motor generator sets for use in supplying street railway and commercial direct current services, representing a total connected rotary capacity of 36,550 kv-a.

We have three 5000 kv-a. synchronous condensers, one at Carlaw Substation, one at Duncan Street

Interior view of Duncan Street Station.

Substation and one at West Toronto Substation. These are used for power factor correction and voltage regulation, the latter function being particularly useful after midnight to protect street lamps from high voltage. Two 6,000 ampere hour 125-250 volt storage batteries, used as an auxiliary or in case of power failure on commercial direct current are installed in the Terauley and Scott St. Substations and are for use mostly in the downtown districts. These are two of the assets taken over with the T.E.L. stations. One of these batteries has been known to carry, at times of power failure, as much as 20,000 amperes for 15 minutes.

In addition to this major equipment, the stations contain an appreciable amount of auxiliary equipment, such as current transformers, oil switches, disconnecting switches, potential transformers, switchboards with instruments, relays, and so forth. For instance, there are 679 oil switches of all types on the System. To contain the control, metering and relay equipment for all this apparatus, we have a total length of slate switchboard which, if put end to end, would measure over a thousand feet. These are just a few illustrations of what the stations contain.

Included in the general upkeep of our stations is the repairing and preservation of mortar joints that have become water washed, roofing repaired, all broken glass replaced, painting of exterior parts for preservation and interior for decoration and dust prevention. This last item, aside from the decorative feature, is an important matter, taking into consideration the effect of dust on different apparatus. In many cases, painting of concrete floors is satisfactory, but again, in other cases, it is not so good. For instance, we could never keep our rotating machinery in good condition until we laid tile. The paint soon wears with the moving of heavy machinery and apparatus over it, as well as the constant traffic, until it is only a short time when commutators of converters are scratched with grit

and bearings begin to heat, due to the gritty dust working its way into the bearing, mingling with the oil and spoiling the babbitt. Both of these conditions were quite prominent with us, previous to the laying of tile floors, but since then we have had very little of this trouble.

The characteristics of nearly all electrical apparatus are such as require careful adjustment, regular attention and quick repairs when damage occurs. Therefore, our maintenance staff consists of trained men divided into repair and inspection gangs. These men are all graded according to their ability for any particular work and are classified as switch inspectors, rotating machinery repair men, battery maintenance, supervisory control and handy men. The switch inspectors inspect all switches, including about 12 different designs, from once to three times a year, according to the type and importance of the service to which they are connected. This is done by removing the oil pot or pots from the switch, adjusting contacts, tightening all loose nuts, filing off burnt tips, testing oil and going over the whole switch thoroughly, cleaning, oiling and testing for correct operation. Not only is the switch inspected but so is all the subsidiary equipment belonging to it, including bus bar compartments, disconnecting switches, controls and so forth. Usually the whole equipment in one station is taken care of at one time. Rotating machine men are called on to make any repairs necessary to a machine whether it be re-babbitting a bearing or re-winding an armature, turning down and grinding a commutator or any one of a number of things. It is common practice for us now to wind all machines of 13,200 volts and under. This sometimes includes the making of new coils. Where it is possible to do this work with our own men, we generally have very satisfactory results and a saving in cost. We consider these men capable of stripping a machine to the iron and building it up new.

We have decided within this last year that all transformers should have a regular inspection, due to the fact that upon opening up an occasional one, invariably the core was covered with sludge, oil dirty, nuts and bolts loose, tanks rusting, etc., so that now we have a regular gang that work with the object of inspecting every transformer once every five years. Since commencing this work last fall, our decision has proven well founded, as, out of about three dozen transformers there has not been one which has not warranted the cost expended. We have found the whole framework at the bottom of cores ready to drop off, and frequently the nuts on the clamping rods are on the bottom of the tank. Invariably there is a considerable amount of sludge on the bottom. One or two screwdrivers have been found, and in one tank a half a large box of matches was found wedged under the frame (still in good condition).

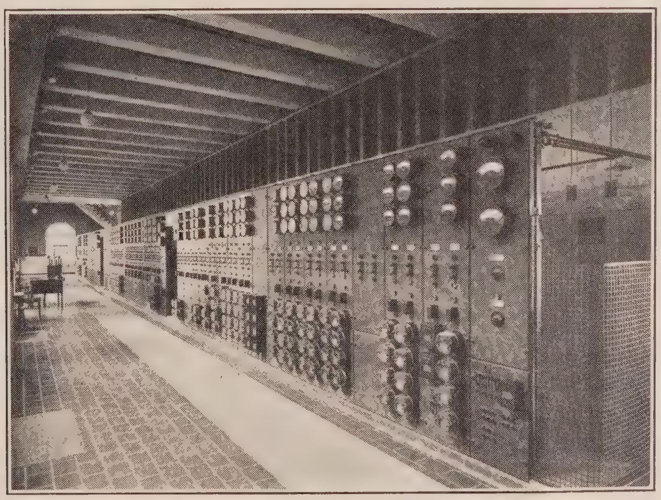
To take care of oil purification on the system, the major portion, of course, being in the transformers, we do not use the old-time blotter filter press with its sixty or seventy blotters placed side by side, any more. This filter could remove most of the foreign matter but would remove only

a small portion of the water amounting to not over a quart and a half, then the blotters had to be disposed of. We have in service now a much more improved system for this purpose, by the use of a centrifugal oil purifier. This machine will purify from 150 to 300 gallons per hour, according to the condition of the oil and regardless of water. This purification in one operation will raise the dielectric strength from zero up to between 22,000 and 26,000 volts, using the standard disc gap of .1 inch, providing the oil is properly heated to a temperature of 120 degrees Fahr.

Previous to the adoption of this method, when the oil in a circuit breaker was bad, it was disposed of, and occasionally when there was considerable water and sludge in a transformer, it was cheaper to let it run away than purify it by the blotter system. We had actual proof of this just before we decided to look into the merits of the present system.

Station construction work is more standardized, insofar that it covers the installation of standard apparatus and does not require the individual man to cover so wide a field as in maintenance. However, mechanics do have to be well up in the knowledge of electrical and mechanical apparatus in general, since it involves installation for the first time, and there are many parts of the routine of installation supposed to be known, according to our standards, without new instruction. Construction work as a rule is installed according to blueprints supplied. All mechanics are required to read prints intelligently. Helpers must learn to do this before they can become mechanics; and in laying out a large piece of work there are quite a number of prints to follow up. The layout may be complicated and very often varies from a standard.

In the Station Construction Section there are a few recent installations and incidents which might be of



Switchboard in High Level Station.

interest. One is the installation of the synchronous condenser at Carlaw Substation. This is the only one on the system that is entirely automatic, that is, the operator, to start or stop the machine, has only to pull the control switch on the 4,150 volt oil breaker. The relays and contactors, equipped with timing features, perform the many detail operations necessary, more correctly than can be done by manual operation. These features are all interlocked, so that in the starting sequence nothing can come in out of place and cause damage. For instance, the bearing supply oil pump is supposed to be started and up to pressure before the starting switches are thrown in. This forces oil at a pressure of about 175 lbs. against the bottom of shaft, through the bearing, actually raising the shaft and placing a film of oil of about 1-32 of an inch thick between the bearing and the shaft. Otherwise the shaft would be resting on the bearing and the machine would not start, owing to its weight, and the switches that had come in so far, on the sequence, would automatically drop out and start over again. This scheme is rather unique insofar as it was designed in our own office and works to perfection.

Each day, before four o'clock in the afternoon, the maintenance and construction sections send in their work requests to the office, for the following day's work. These work requests ask for the clearance of a particular piece of apparatus to be worked on at a certain time and are telautographed in to the Duncan St. office from Scott Street. After being typed on printed forms, they are sent to the Operating Department, where they are taken care of. If the request is granted, notification is sent to the Load Engineer, who takes care of same.

An interesting phase of the work is now being carried on along the lines of protection to apparatus, cables, etc., namely, alterations to the protective and control feature of our stations, with a view towards speeding up circuit breaker operation and obtaining greater reliability of service. Additional current transformers and relays are being installed on all 13,200 volt feeder circuits, making each phase of a feeder equally protected. Transformer banks are being provided with a new type of protection which consists of balancing incoming currents against outgoing currents and which serves to clear them instantly, should internal trouble develop.

A system of ground relay protection has been introduced and is being installed, which serves to speed up the time of relay and breaker operation very materially.

Four grounding reactors have been installed at selected points, these serve to permit a regulated flow of current to pass through ground faults. When such develop, these ground currents in turn actuate instantaneous relays, serving to clear the fault apparatus, frequently before the trouble has had an opportunity to develop into disagreeable proportions. With this scheme a circuit breaker can be cleared in a matter of from 1–5 to 2–5 of a second after the trouble develops. A similar system to this has been known to save a man's life who got in contact with 13,200

Regulator Bay, Wiltshire Ave. Station.

volts. This system will be put into operation shortly and we have great expectations for its successful operation.

Wherever possible, the 13,200 volt feeders have been paralleled and balanced relay protection installed. This also gives fast operation, the breakers opening up instantly wherever any unbalance in the currents flowing in the two feeders, due to faulty conditions of either one, occurs.

We have all come in touch, more or less, with supervisory control. It is a very interesting subject and is being given serious consideration by nearly all the larger power companies. Its principle is so attractive, and its possibilities so great, that the future can only show what this adjunct to station control will bring. Engineers of all large companies are giving it attention, and a few have ventured with the idea of centralizing the control of the entire system and operating from one point. This provides, incidentally, another long-wanted means of assisting operation without entailing almost prohibitive expense as at present. A system diagram on a large scale can be electrified in such a manner that the return signals of a switch, indicating in or out, come over the supervisory connections, lighting up similar lamps in parallel, on the diagram, indicating the location and position of the switch just operated. This does away with the present method of depending on the Load Engineer to make all changes.

We have four of such equipments in operation at the present time, and, another on order. We find these equipments quite reliable and they are certainly a great saving insofar as the cost of building, switchboard and manual operation is concerned.—*The Bulletin, Toronto Hydro-Electric System.*

Canada produced in 1925 nearly thirty per cent of the newsprint paper made in the world. — *Natural Resources, Canada.*

The Japanese Electrical Industry

A RECENT visitor to the Commission was Mr. Yeiichi Saito, Manager of the Kyushu District of the Toho Electric Company, Limited, Tokyo, Japan. Mr. Saito was very much interested in the manner in which power is supplied to the municipalities in the Province of Ontario through the Commission, and left with us a report of his Company and other literature descriptive of the Japanese electrical industry. Some of the more interesting features described are outlined in the following, the Japanese money values shown in the reports being converted to our own standard on the basis of a yen being approximately equal to fifty cents.

The first electric light company was organized in Tokyo in the year 1887, starting business with one crude generator of a capacity sufficient to supply electric current for 75 carbon lamps. In 1925 the capitalization of the electrical industry was estimated at over $1,200,000,000, there being over 3,124,000 kilowatts of electric generating capacity. It is estimated that the industry is expanding at the rate of 10 to 15 per cent per year, making an annual requirement of new capital of between $100,000,000 and $150,000,000.

The Toho Electric Power Company, Limited, is the outgrowth of a company organized in 1889, which in the course of development has amalgamated several power producing companies so that it is now the second largest retailer of power in Japan. It serves an area of approximately 4,110 square miles with a population of about 5,584,000. Its generating and purchasing agreements give the company a capacity of approximately 323,000 kilowatts. This company generates by both hydraulic power and steam, the capacity of the latter being about double of the former, while purchased power amounts to about one half of that generated. The hydro-electric plants use water from the Japan Alps and carry the base load during wet seasons, the peaks being provided for by the steam plants. The steam plants being located close to the chief coal deposits carry the base load during the dry seasons while the hydro-electric plants take care of the peaks.

Generating equipment in use in Japan is principally British or United States manufacture, housed in steel frame, reinforced concrete buildings that are both fire and earthquake proof. The generators in one of the recently constructed stations are of steel plate construction. Practically no castings enter into their construction, the stator frame being built up of steel plates and shapes welded and bolted together. This construction eliminates the risk of casting breakage in transit and affords higher factors of safety with less total weight. These particular generators have each a capacity of 10,125 kv-a.

Transmission voltages range between 11 kv. and 77 kv. while distribution lines are being standardized by some companies at 3500, 220 and 110 volts. There are underground lines operating at 22 kv. and 11 kv.

Typical rates for electrical service as used by the Toho Electric Power Company, Limited, are somewhat unusual and are outlined in the following:

Lighting Rates

Flat Rate:

Size of Lamp	Charge per Month	Size of Lamp	Charge per Month
8 c.p. (outdoor)	$0.175	36 c.p.	0.43
8 c.p. (indoor)	0.25	50 c.p.	0.49
16 c.p.	0.295	100 c.p.	0.875
24 c.p.	0.36		

Meter Rate:

For meter rate the number of lamps connected per household should be 5 or above.

The following minimum charge entitles a customer to use 1½ kw-hr. per lamp per month:

Number of lamps per household	Min. charge per lamp per month	Number of lamps per household	Min. charge per lamp per month
5 or over	$0.14	20 " "	0.11
10 " "	0.13	30 " "	0.105
15 " "	0.12	50 " "	0.10
20 " "	0.115		

When the energy used is more than 1½ kw-hr. per lamp per month, the energy charge will be as follows:

Use of energy per lamp per month	Charge per kw-hr.
Above 1½ kw-hr. to 3 kw-hr.	$0.07
" 3 " " 5 "	0.055
" 5 " " 8 "	0.04
" 8 "	0.03

In addition the following charge is made for the rent of meters:

Size of Meter	Charge per month	Size of Meter	Charge per month
3 ampers	$0.25	15 "	0.375
5 "	0.275	25 "	0.50
10 "	0.30		

Power Rates

Flat Rate:

Size of motor	Charge per month: Day Service	Charge per month: Day and Night Service
½ h.p.	....	$5.00
1 h.p. or above	$3.75 per h.p.	$6.50 per h.p.
5 " " "	3.50 " "	6.00 " "
10 " " "	3.25 " "	5.50 " "
20 " " "	3.125 " "	5.25 " "
30 " " "	3.00 " "	5.00 " "

Special arrangement may be made for the flat rate for a motor of 50 h.p. or above.

Energy charge for meter rate is 2 cents per kw-hr.

The minimum charge is as follows:

Size of motor	Min. charge per h.p. per month
1 h.p. or above	$3.625
5 " " "	3.50
10 " " "	3.375
20 " " "	3.25
30 " " "	3.125

Special arrangement may be made for the minimum charge for a motor of 50 h.p. or above.

The use of electric motors for farm work is increasing rapidly, especially in irrigation of rice fields and for drainage works. A new electric energy market is being developed in farm belt works, silk and tea industries. Experiments have been carried out on the use of electricity for heating in public bath houses, and it was proved very economical. Off-peak power was used to heat the water during the night, while during the day just enough power was supplied to make up for the heat lost by radiation. The porcelain industry also promises to be a good market for off-peak power. A porcelain oven takes about 50 kw. and it has been found that with electric heating, two ovens of porcelain can be baked during a night instead of one as in the case of other fuels.

Less than 75 years ago, as for 300 years before, Japan was governed under a closed-door policy. All advancement she has made from her own isolated civilization has been done since then. The growth of the Japanese electrical industry may no doubt be taken as an example of the progress made. Though the local conditions may differ from those in the countries whose standards she chose to copy, yet the electrical industry is proving a favoured field for foreign investors, and each installation as it is made is as up-to-date and modern as the progress of engineering science has made possible.

Experimental Electric Shock

By R. W. Ian Urquhart, M.A., M.B., Laboratory of Physiology, University of Toronto

(*Extract from The Journal of Industrial Hygiene, Vol. IX, No. 4, April, 1927.*)

THIS research had its inception in the previous work of Mr. Wills Maclachlan, Consulting Engineer, Toronto, on the history and methods of resuscitation as applied to the victims of electric accidents. As a result of this work, it was evident that if any progress were to be made in this field it would be necessary to obtain further information as to the actual effect of the electric current on laboratory animals. Accordingly, at Mr. Maclachlan's suggestion moneys were obtained from the Hydro-Electric Power Commission of Ontario, to defray the expenses of an investigation into the causes of death from electric shock and, if possible, to learn if anything further could be done to aid in the resuscitation of its victims. Arrangements were therefore made with Prof. J. J. R. Macleod of the University of Toronto to carry out such an investigation in the Department of Physiology under his direction. Electrical facilities were supplied by the Hydro-Electric Power Commission of Ontario.

The startling and frequently fatal results observed when a person comes into contact with a charged electric conductor have excited the interest of the medical profession since 1879, when the first fatal accident occurred from a dynamic electric circuit. Many researches have been undertaken to discover, if possible, the cause of death in such cases and to formulate suitable remedial measures to protect those exposed to the possibility of such accidents. The men in the field, on the other hand, have been concerned mainly with the perfection of safety appliances and with the adoption of preventive regulations in order that these untoward accidents may be reduced to a minimum. The practice, now almost universal, of instructing the field worker in the recognized principles of resuscitation, has been the means of saving many lives. With the increasing use of electric energy in industry, however, the number of casualties continues to grow, owing either to the lack of immediate application of the now known principles of resuscitation or to fatality in spite of their efficient application. The necessity for further investigation into these problems becomes evident.

Review

Jex-Blake (1), in the Goulstonian Lectures of 1913, reviewed and summarized the whole field of electric shock up to that time. He quotes largely from the outstanding work of Prevost (2) and Battelli (3). From his wide study of the reported experiments on animals and of the records and statistics of accidents to human beings, he reaches the following conclusions and applies them to man:

1. The existence of an idiosyncracy to electric currents in man is doubtful.

2. Death in human beings may occur in different ways:

a. It may be brought about by a prolonged tetanus, causing death by asphyxiation;

b. By primary heart failure or ventricular fibrillation;

c. By failure of respiration, either through nerve inhibition or through actual damage to the central nervous system;

d. By delayed death, the result of burns or complications.

3. The electrical details are of great importance. With high voltages (over 500 volts) the brain and the spinal cord are more often affected, while with lower voltages the heart is the usual point of action.

4. Artificial respiration is recommended as the only method of treatment holding out any hope. (This may or may not be accompanied by so-called "counter shock," *i.e.*, stimulation of sensory nerves by pressure or blows.)

Apart from subsequent minor additions to our knowledge of the subject, these conclusions may properly be regarded as representing the present general conception of the problem. Reference must, however, be made to the work of Jellinek (4) who, by performing numerous experiments on animals and by collecting data from the reports of a large number of accidents, has contributed much to the literature on the subject. Jellinek stresses the importance of immediate and continued application of efficient artificial respiration, particularly when the "apparent death" is due to respiratory failure. He believes that if fibrillation of the heart is present, the slight massage afforded by this measure may have some beneficial effect on the patient.

Borruttau (quoted in (5)), in 1918, from a study of the records of fatal accidents in Germany, reported that 90 per cent. of the fatalities were due to ventricular fibrillation and suggested that continued artificial respiration is useless unless evidence is obtained that the circulation is intact.

As a result of this work on dogs, MacWilliam (6) also subscribes to the theory that ventricular fibrillation is the most important fact in electric fatalities.

Scott Ram (7) made an analysis of the records of electric accidents in England from 1912 to 1921. In the majority of the cases, artificial respiration had been attempted. He points out that of those who had received over 650 volts, 62.5 per cent recovered, while only 39 per cent of those who had received under 250 volts were saved. This gives some indication as to the determining factor in the fatality. The higher voltages have a somewhat selective action on the respiratory apparatus, and artificial respiration is frequently of value; while the lower voltages act mainly on the heart, causing an irremediable fibrillation. Provided proper treatment by artificial respiration is promptly applied, the risks to life are therefore decidedly less with relatively high voltages than with lower ones.

The available records of electric accidents in Ontario to some extent confirm these conclusions. A relatively higher percentage of recoveries is apparent and may be attributed:

first, to the nature of the current—the majority of the power lines carrying high tension; and, secondly, to the organization and training of the electrical worker in the prone pressure method of artificial respiration. How further to increase the percentage of recoveries is the problem with which we are confronted.

An important fact, first observed by Prevost (2) and Battelli (3) and later confirmed by many other workers, is the decided difference in the effect of similar electric currents on animals of different species and, indeed, although in a less marked degree, on animals of the same species. Great care must therefore be taken in the interpretation of experimental evidence and in its application to man. This is particularly true in regard to observations on the heart. The marked difference in the susceptibility to ventricular fibrillation of t ıe heart of the dog and of the rabbit is well known, whereas there does not seem to be the same variability in the reaction of the nervous system in these and other animals. The effect of the electric current on these two systems has, however, been clouded by the involvement of other parts of the body in the path of the current. It seemed to us important that the problem should be reinvestigated by making observations in which the electrodes were so placed that the nervous system and the cerebral nerve centre would alone be involved, and it is with an account of these investigations that the present report is concerned.

Present Investigation

Inasmuch as the rabbit's heart is relatively difficult to throw into fibrillation, it was decided to use this animal in the majority of the experiments, and, in the light of the results thus obtained, to repeat the observations on a sufficient number of cats and dogs to make it possible to form an opinion as to how far they might be applicable to man.

Equipment

With the excellent electrical facilities supplied by the Hydro-Electric Power Commission of Ontario (Fig. 1) we were able to obtain currents of any desired magnitude. The commercial 25-cycle 110-volt alternating current came in through 30-ampere fuses and was connected, through a time switch controlled by a potentiometer, to a 3-kilowatt transformer with a ratio of 10:1. On the high tension side a water resistance which could be varied between 100 and 11,000 ohms was inserted. In series with the grounded side of the high tension circuit, a 3-ampere ammeter was connected. For the preliminary experiments, a 75 to 150 range alternating voltmeter with a potential transformer having a ratio of 10:1 was used. With this equipment, we were able to deliver at our electrodes a current of very definite strength for a definite time. We were, furthermore, enabled to measure the voltage and the amperage during the actual passage of the current through the animal. With reasonable care in the adjustment of the electrodes, we could duplicate the experimental conditions very readily.

Effects of Current

The results were found to vary considerably according to the parts of the body to which the electrodes were applied and according to the exact

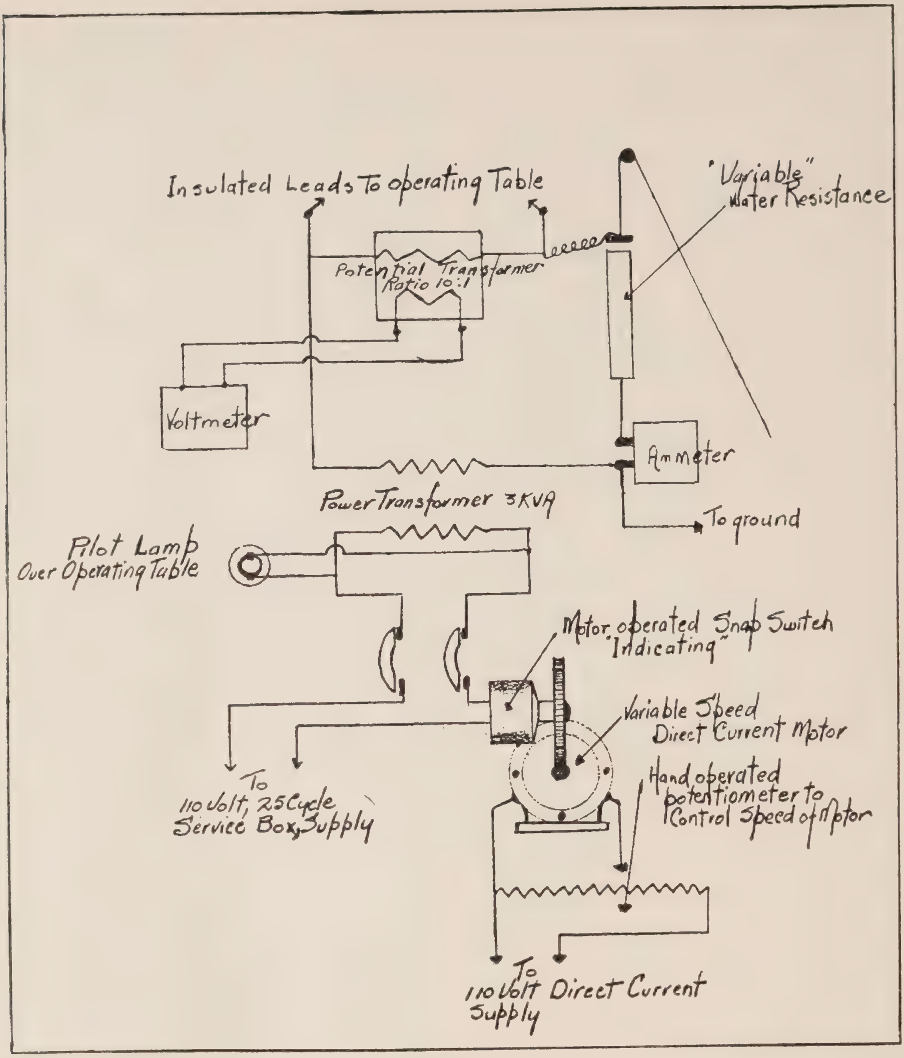


Fig. 1. Diagram Illustrating Electrical Detail Used Throughout the Work.

design of the electrodes. For the first series of experiments, and in a few preliminary experiments, the electrodes consisted of two flexible strips of copper, one being 2 by 4 cm. and the other square with an area of 2.25 sq. cm. The former was wrapped tightly around a previously shaved and moistened hind limb, while the latter was curved slightly and fitted on to the shaved occiput. According to Prevost and Battelli and other observers, a high tension current traversing the body between these electrodes will ordinarily miss the heart but will cause disturbances in the brain and the spinal cord. A total of sixty experiments with electrodes

of this type were performed on thirty-three animals.

Analysis of these experiments shows that in nine of the thirty-three cases spontaneous respiration occurred following the application of the electric current. In six others, artificial respiration brought about recovery. The remaining eighteen animals died. In one-half of these the heart stopped beating within one minute after the cessation of the current, while in five of the seven to which artificial respiration was applied the heart continued to beat for from two to nine minutes. Four of the fatal cases in which no artificial respiration was employed and in which the heart beat persisted for from two and one-half to three and one-half minutes are grouped by themselves since the probable factor causing death was uncertain. For the other fourteen fatal cases, it seems to be fairly evident that the heart, quite apart from fibrillation, had been damaged in some way by the currents, since it stopped beating either within one minute of the application of the electric current or at a later interval in spite of continued artificial respiration. We would conclude, therefore, that when a current of high tension traverses the body from the head to a posterior limb, the heart is injured in approximately 45 per cent of the cases. Of the others (55 per cent) some die of respiratory failure, and it is probable that in those which survive very little of the electric current can have passed directly through a vital center. It is to be noted that the ratio of these figures may be somewhat related to that of Scott Ram's figures which have been quoted above.

These observations demonstrate that when the electric current traverses the length of the body, it is impossible to predict whether or not the heart will be affected. We therefore undertook a second series of experiments in which the electrodes were applied to the head in such a manner that the current would pass through the vital centers of the brain, the object being to determine the exact condition of current strength and the durtion causing death when these centers alone are involved.

Using the same electrodes as in the previous series of experiments and placing them in various situations on the head and neck, we found that we were unable to bring about a permanent cessation of respiration. The current was evidently being shunted around the bony skull through the subcutaneous tissues. Electrodes of a different type were then devised and used in all the succeeding experiments.

One of the electrodes consisted of a straight piece of No. 8 copper wire about 2 inches long, which was inserted well back in the nasal cavity. The second electrode was arranged to fit snugly on the exposed atloido-occipital ligament. It consisted of a small brad insulated to its tip and attached to the bend of a piece of heavy copper wire shaped in the form of a horseshoe. The tip of this electrode was about 0.1 sq. cm. in area and it was maintained in the proper position by elastic bands passing through the animal's mouth and hooked on the curved arms of the horseshoe shaped support. The tension of the elastic bands kept the electrode firmly in place, thus insuring proper contact at all times.

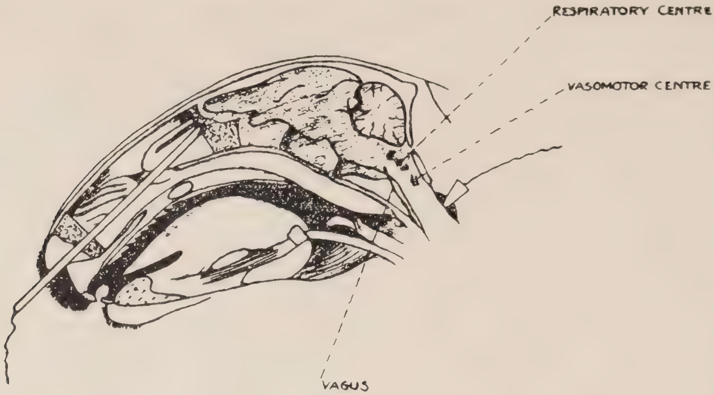


Fig. 2. A vertical section through a rabbit's head, showing the location of the electrodes and the approximate location of the chief centers involved in the path of the current.

For this series of experiments, it was necessary to anesthetize the animal. There has been some discussion as to the "protective action" afforded by an anesthetic. It is doubtful if it exists. We have attempted to avoid this possible complicating factor by waiting after the initial operations until the anesthesia had become less profound. Thus, we have always been careful to obtain the eye reflex before administering the electric current although the animal was obviously unconscious. We do not think that our results have been seriously influenced on account of anesthesia, since there has been no evidence that the depth of this affects them.

The procedure was as follows: The animal was anesthetized and cannulas were inserted in the trachea and into the carotid artery. The atloido-occipital ligament was then exposed, the special electrode placed in position, and the other electrode inserted in the nasal cavity. After allowing the animal to recover somewhat from the anesthesia, the desired electric current was passed between the electrodes for a definite time. Figure 2 illustrates in a diagrammatic way the path of the current and the location of the vital centers which it affects.

In experiments on eighteen rabbits the heart beat ceased within a few minutes after receiving electric currents which varied in strength from 500 to 1,600 milliamperes and were applied for one and one-half to three and one-half seconds. On the application of the current, the animals went into a generalized contraction which was maintained for the duration of the shock. When the current was broken, a few clonic convulsions occurred, followed in a few seconds by complete muscular relaxation during which the mucous membranes became dark and the pupils dilated. At a later interval (in from three to six minutes) the heart could no longer be heard. Subsequent exposure of the heart revealed no evidence of fibrillation and at the point of contact of the electrodes there was no visible destruction of tissue. Apparently

death in these cases was purely of the asphyxial type.

In certain other instances, the electric current did not cause death, and respiration returned voluntarily after a variable time had elapsed. In the majority of instances the fatal cases received more current than did the nonfatal. In the case of amperages which might or might not be fatal, it is possible that the electrodes were so placed that the mass of the electric current missed the vital centers. There does appear, however, to be a more or less definite border line between fatal and nonfatal amperages and one can say that with the smaller electrode the fatal amperage is between 600 and 700 milliamperes applied for two seconds. In experiments in which the time of application of the current and the method of applying the electrodes were kept constant the proportion of animals which died or presumably would have died, had artificial respiration not been applied, increases approximately parallel with the amperage until a point is reached where gross damage to the tissue takes place. This damage, as will be shown later, always occurs when the capacity of the contact area is not sufficiently large to carry the current. When there is no damage to the cord, it may be said that the seriousness of the result is proportional to the amount of current which the animal receives through its vital centers—*viz.*, respiratory, vasomotor, etc.

In this connection it may be noted that fatal apnea was produced by electric currents varying greatly in amperage when the size of the electrodes on the atloido-occipital membrane was also varied. For example, when the electrode with an area of 0.1 sq. cm. was used, a current of 600 milliamperes was sufficient to cause a fatal apnea. When the area was increased to 0.36 sq. cm., 1,200 milliamperes were required. The explanation no doubt lies in the fact that in any conductor, the current density at any point is directly proportional to the area at that point. Therefore, the smaller the electrode, the more concentrated is the current and the greater is the damage to the tissues in its path.

Artificial Respiration

Having determined the approximate conditions under which fatal results are to be expected, we then proceeded to study the effect of artificial respiration on animals that had been given a shock which, in the vast majority of instances, was of sufficient amperage to be fatal. A total of thirty such experiments were performed.

Artificial respiration was applied in from one to five minutes after the electric current had been switched off and was maintained until either recovery had taken place or definite evidence of death was established. We were able to bring about recovery in twenty-five cases and failed to do so in five. In those which recovered, the first attempt at voluntary respiratory effort was observed to occur within two minutes after the shock in one-third of the cases, while in the remainder a longer interval elapsed—as much as twelve minutes in one case. The respirations were at first irregular and gasping in character but in a few minutes they gradually became more regular and approximated the normal.

In some instances, notably those in which the initial voluntary respirations were the most delayed, the gasps succeeded one another at the same rate as that at which the artificial respiration had been applied. When sufficient recovery had taken place and artificial respiration could be withdrawn, the respirations gradually became normal in character. It is evident that in the delayed cases the depression of the respiratory center was more pronounced than in the others in which the period of apnea was shorter. The significant thing is, however, that artificial respiration adequately applied was sufficient to bring about recovery in about 75 per cent of the cases.

In the five cases in which artificial respiration failed, subsequent examination revealed that gross damage had been done to the spinal cord or the medulla. The atloido-occipital ligament had been badly charred and in some cases had been burned. The head of the electrode had in some instances penetrated half through the cord. This damage we shall describe as pithing, and in fact the animal in such cases behaved in all respects like a so-called "pithed" animal.

Pithing occurs, as we have stated above, whenever the capacity of the contact area is insufficient to carry the current, or, in other words, when the resistance at this contact point does not allow the current to flow freely. This contact area is composed on the one side of the atloido-occipital membrane, the resistance of which will become increased as a result of drying, such as may occur after prolonged application of the current. One would therefore expect that with the larger electrode (0.36 sq. cm. in area) a greater volume of current could be carried without causing damage because of the decreased concentration of current per unit area. On the other hand, the passage of an electric current through a conductor of relatively high resistance (such as tissue) generates heat and as a result charring occurs, and the greater the resistance the more quickly does this occur. Thus a current of 1,000 milliamperes flowing for two seconds through an electrode having an area of 0.1 sq. cm. frequently produces pithing, while with an electrode with an area of 0.36 sq. cm. it requires at least 2,000 milliamperes, applied for the same length of time, to produce a similar result.

The limitations introduced by this factor became of importance in our next experiments, which were planned for the purpose of studying the effect of remedial measures other than artificial respiration. Since it was necessary to apply an electric current which would so injure the respiratory center that artificial respiration in itself was ineffective in restoring the animal, the current was increased, but usually when 2,000 to 2,500 milliamperes were given pithing occurred even when the larger electrode (0.36 sq. cm. in area) was used. Pithing also occurred when a current of only 500 to 600 milliamperes was applied for a longer period (three to five seconds). We were, therefore, forced to abandon this method of procedure.

We were satisfied, however, that the current which we were able to employ without causing gross damage to the spinal cord was insufficient to injure permanently the respiratory center and that prompt and efficient applica-

tion of artificial respiration practically always assured recovery of the animal, provided it was started within five or six minutes following the application of the shock, since at longer intervals irremediable damage had been done to the heart. It was further found necessary to maintain the artificial respiration for a considerable period of time after the first appearance of breathing by the animal itself. In some instances in which the application of artificial respiration had resulted in a return of natural breathing, it was noted, for example, that immediate withdrawal of the artificial measures was followed by the cessation of the animal's own efforts (Chart 4). Re-application of artificial respiration in such cases was usually successful in bringing about complete recovery. In other cases where the current was not so great, the momentary application of artificial respiration was all that was necessary to restore natural breathing. One cannot emphasize too much the necessity of early and continued application of artificial respiration in electric accidents.

Counter Shock

There has been much discussion in the past with regard to the efficacy of so-called "counter shock" or "counter stimulation." The men in the field have repeatedly observed that the victim who falls from a height, following an electric shock, is more readily resuscitated than one who does not have such a fall. This has been attributed to the mechanical stimulation resulting from the body's striking the ground. This idea has led to the employment of some rather drastic measures of treatment. The evidence of the value of such treatment has never been convincing and the recent work of Campbell and Leonard Hill (8) goes far to discredit it. We have further evidence which confirms this view.

Since counter shock by mechanical means must act by bringing about stimulation of sensory nerves with a resulting reflex excitation of the respiratory and other vital centers, our experiments have consisted in stimulation, with faradic shocks of moderate intensity, of the central end of the sciatic nerve in rabbits which had received apparently fatal electric shocks in the manner described above. No recoveries were obtained when artificial respiration was not at the same time applied. Furthermore, no evidence could be obtained, either in the behavior of the animal itself or in the arterial blood pressure tracings, to show that such stimulation was having any reflex effects (Chart 6). Even in those cases in which the animal was kept alive by artificial respiration it was impossible to detect any reflex effects on blood pressure or any improvement in the rate of recovery. We were, therefore, forced to conclude that counter stimulation has no demonstrable effect on resuscitation from electrocution in laboratory animals.

(*Continued in June Number*)

HYDRO CALENDARS

On the opposite page is illustrated a sketch of a proposed 1928 Hydro calendar.

This is a sketch only, subject to revision and alteration to meet the desires of Hydro municipalities.

Copies of this sketch have been sent to all municipalities for their comments or for their orders if they are satisfied with the design and general make-up.

The calendar will be a one-page calendar printed in four colours showing Niagara Falls illumination at its best, and on this one-page back will be attached a 12-page calendar pad in the usual way. On each page of the pad at the bottom will be illustrated a principal episode in the development of Hydro, with a little story.

These calendars will be furnished to any Hydro municipality at the cost of 6½c. net f.o.b. Toronto, not including mailing envelope but allowing for the imprint of the name of the local institution as well as any other information that it is desired to put on the bottom of the calendar.

We would be glad to have you place your orders early so that the sketch may be turned into a real painting and the work of preparing the calendar for final distribution proceed with without delay.

Fill in the order blanks which have been sent to you and mail them in to

SALES DEPARTMENT

of the

HYDRO-ELECTRIC POWER COMMISSION


THE POWER BEHIND THE HOME
1927 JANUARY 1927
1
2 3 4 5 6 7 8
9 10 11 12 13 14 15
16 17 18 19 20 21 22
23/30 24/31 25 26 27 28 29
THE MUNICIPAL HYDRO ELECTRIC SYSTEM

Water Power Resources of Canada

(Extracts from Bulletin No. 1055, Department of Interior, Canada, Dominion Water Power and Reclamation Service).

THE brief review of the water power resources of Canada which is presented herein by the Dominion Water Power and Reclamation Service of the Department of the Interior, Ottawa, does not attempt to analyze in detail the various phases of distribution, adaptability and development of this, one of Canada's greatest natural resources, but deals only with the salient features, leaving detailed discussion to other publications which the Service issues from time to time.

The steady, consistent growth of hydraulic installation emphasizes the necessity and importance of an annual inventory of our water power resources in order that accurate information as to the total available and developed water power of the country may be available.

By the end of the year 1926 Canada's hydraulic installation reached a total of 4,556,266 h.p., of which 265,838 h.p. was installed during that year. While the addition for 1926 was substantial, it falls far short of indicating actual constructional activities as projects under way, a number of which are nearing completion, will ultimately add to the Dominion's total more than 1,700,000 h.p., while others in active prospect indicate a further addition of 1,000,000 h.p. As the capital investment due to these developments under construction and in prospect is estimated at approximately $270,000,000 regardless of the extra capital required in the application of their power output some idea is gained of the stimulus which will be given industry by their completion.

Complete information regarding Canada's great water power resources is not yet available but all existing stream flow and power data from federal, provincial and private sources have been systematically collated, analyzed and co-ordinated with the object of presenting a dependable estimate of available power based on uniform methods of computation and arrangement.

Basis of Computation

The figures for available water power listed in Table 1 are based upon rapids, falls and power sites of which the actual existent drop or the head possible of concentration is definitely established or at least well authenticated. Many rapids and falls of greater or lesser power capacity are scattered on rivers and streams from coast to coast which are not as yet recorded, and which will only become available for tabulation as more detailed survey work is undertaken and completed. This is particularly true in the relatively unexplored northern districts. Nor is any consideration given to the power concentrations which are feasible on rivers and streams of gradual gradient, where economic heads may be created by the construction of power dams, excepting only at such points as definite studies have been carried

out and the results made matters of record.

In brief, the figures hereunder are based on definite rapids, falls and power sites, and may be said to represent the *minimum water power possibilities of the Dominion.*

The power estimates have been calculated on the basis of 24-hour power at 80 per cent efficiency for conditions of "Ordinary Minimum Flow" and "Ordinary Six Months Flow." The "Ordinary Minimum Flow" is based on the averages of the flows for the two lowest periods of seven consecutive days in each year, over the period for which records are available. The "Ordinary Six Months Flow" is based upon the continuous power indicated by the flow of the stream for six months in the year. The actual method to determine this flow is to arrange the months of each year according to the day of the lowest flow in each. The lowest of the six high months is taken as the basic month. The average flow of the lowest seven consecutive days in this month determines the ordinary six-month flow for that year. The average of such figures for all years in the period for which data are available is the ordinary month's flow used in the calculation.

Estimates of power on the basis of ordinary six month flow are made upon the assumption that it is good commercial practice to develop wheel installation up to an amount, the continued operation of which can be assured during six months of the year, with the deficiency in power during the remainder of the year provided from storage not yet created or by the installation of fuel power plants as auxiliaries. The correctness or otherwise of this assumption for any particular site can only be definitely settled by careful consideration of all circumstances and conditions pertinent to its development. The method, however, enables a fairly satisfactory over-all estimate of the maximum hydraulic power available to be made as distinctive from the estimated ordinary minimum power available.

Available and Developed Totals

The known available water power in Canada, from all sources and within the limitations outlined, is 18,255,000 h.p. for conditions of ordinary minimum flow and 32,076,000 h.p. ordinarily available for six months of the year.

It is believed that these are conservative estimates since an analysis of the water power plants scattered from coast to coast concerning which complete data are available as to turbine installations and satisfactory information as to stream flow, gives an average machine installation 30 per cent greater than the ordinary six-month flow power. Applying this, the figures quoted above, therefore, indicate that the present *recorded water power resources* of the Dominion will permit of a turbine installation of 41,700,000 h.p.

The total installation to date in water wheels and turbines throughout the Dominion is 4,556,266 h.p. In other words the present turbine installation represents *less than 11 per cent* of the recorded water power resources.

Current Progress

The consistent earning power of the various hydro-electric organizations coupled with the fact that the output of new stations is absorbed almost as soon as it comes upon the market has created an impression on capital and established a public confidence that is demonstrating itself in increased hydro-electric construction. Of the 265,838 h.p. installed during 1926 over 219,000 h.p. was installed for public distribution through the medium of central electric stations. Pulp and paper mill organizations installed 44,760 h.p. during the year mostly connected to electric generators and will purchase a considerable portion of the additional installation of the central electric stations. Installations other than for central electric station purposes and in pulp and paper mills totalled only 2,072 h.p., of which 2,000 h.p. was for electro-chemical reduction.

Utilization of Developed Water Power

A study of the uses to which the 4,556,266 h.p., the present hydraulic installation of Canada, are apportioned, is shown in Table 2 and serves to emphasize the comment already made on the growing importance of the distribution of hydro-electricity through the medium of central electric stations, 3,685,428 h.p., or 80.9 per cent of the total being installed for that purpose.

Pulp and paper mills maintain a hydraulic installation of 526,731 h.p. or 11.6 per cent of the total and in addition are very large purchasers of hydro-electricity from the central stations referred to in the previous paragraph. It is estimated that the electrical output from approximately 425,000 h.p. of the central station installation is so purchased, giving a total utilization of hydro-electricity for the manufacture of pulp and paper of over 951,000 h.p.

General industrial enterprises such as electro-chemical reduction, lumber manufacturing, flour milling, grain grinding, water pumping, etc., employ 344,107 h.p. or 7.5 per cent of the total.

Column 7 of Table 2 shows the total hydraulic installation per 1,000 of population and when it is realized that commercial prosperity is largely dependent upon increasing the output of the workers through the greater use of mechanical power, Canada's high average of 485 h.p. per 1,000 of population, which places her among the leading nations of the world in per capita utilization of water power, assumes its true proportions.

Water Power in the Central Electric Station Industry

Canada's central electric station industry, the generation or distribution of electrical energy for public use, has attained record proportions because of the wide distribution and accessibility of her abundant water powers.

The close inter-connection of water power and the central station industry is evidenced by the fact stated in the discussion of Table 2 that almost 81 per cent of Canada's total hydraulic installation is installed for public distribution. As the percentage of hydraulic development for central

station use is increasing from year to year the electrical output of hydraulic central stations has shown a corresponding increase over the output of those stations using fuel as a source of primary power until during the year 1925, the last for which definite figures of output are available, over 98.3 per cent of the total electrical output of Canada's central stations originated in the energy of falling water. A number of factors contribute to this continued growth, notably the extensive economic radius of modern electrical transmission combined with the fortunate location of water powers in relation to centres of population and industry without adequate local fuel supplies.

At the present time there are 303 hydro-electric generating stations in Canada with a combined installation of 3,685,428 h.p., of which over 3,000,000 h.p. is developed in the highly industrialized but non-coal producing provinces of Ontario and Quebec. It is interesting to note that while the installations in these two provinces are almost equal, 1,508,266 h.p. in Ontario and 1,546,692 h.p. in Quebec, that in Ontario the installation of the commercial stations is less than 40 per cent as large as that of the municipal stations, being only 28.4 per cent of the total for the province while in Quebec the commercial stations have an installation representing 98.8 per cent of the total for that province.

There are in all 213 stations, containing 544 hydraulic turbines of a combined capacity of 2,432,729 h.p. owned by commercial organizations and 90 stations containing 218 turbines, totalling 1,252,699 h.p. operated by municipal or other public organizations. The average capacity of the commercial stations is 11,421 h.p. and of their turbines 4,472 h.p. as compared with corresponding figures of 13,919 h.p. and 5,746 h.p. in the publicly owned stations.

Water Power in the Pulp and Paper Industry

Canada's pulp and paper industry, her leading manufacturing industry in point of gross and net values of manufactured products and leading the world in the output of newsprint, owes its outstanding position to the fortunate occurrence of tremendous supplies of pulp wood in close proximity to water powers readily developable and of such size as to meet the great power demands of this industry. As the conversion of pulp wood to newsprint requires, on the average, an installation of 100 h.p. per ton of daily output, the close proximity of power and wood is essential to the successful development of the industry.

The joint development of the central station and pulp and paper industries lends itself to the advantage of both. Power sites can be developed to their full capacity with a certainty of a market for their entire output, any surplus or off-peak power being readily absorbed in steam-raising in electric steam boilers for mill use and owing to the low cost of the installation just as readily released to a more remunerative market when the demand warrants.

There are at the present time some 117 pulp and paper mills in Canada

operating water power developments to furnish their own motive power. These mills have a combined installation of 526,731 h.p. and a number of them are also large purchasers of power from central electric station organizations. There are still other mills which purchase all their power. While definite figures of this purchased power are not at present available a conservative estimate, recently made, places the amount at approximately 425,000 h.p. indicating a total utilization of hydraulic power by the pulp and paper industry of over 950,000 h.p.

Past and Future Growth in Utilization of Water Power

The modern development of water power in Canada began with the last decade of the nineteenth century by the end of which approximately 170,000 h.p. had been installed. The development of the long distance transmission of electricity about the beginning of the present century provided a stimulus to hydraulic installation which led to fairly uniform annual increases up to the period of the war. Even during the war and the period of depression which followed a large amount of construction was carried on, though of course not at the accelerating rate which might have been anticipated had those conditions not intervened. From 1921 onwards there has been a resumption of activity on a large scale which culminated in the installation of almost 720,000 h.p. in 1925 following a program of construction extending over several years. While the 1926 figure of installation fell short of the record figure of the previous year, another period of great activity is under way which will result in an installation of 1,700,000 h.p. in the next few years.

With new uses for electricity constantly developing there is every reason for believing that hydraulic development will show constantly accelerating growth over past figures. Chief among these new uses may be mentioned railway electrification, the application of electric-heat to manufacturing processes, the more extensive use of electric boilers for process, steam, commercial and domestic electric refrigeration, and other uses constantly appearing. The highest authorities in the electrical field are agreed that the power market has not yet shown any signs of saturation.

Capital Invested in Water Power

The investment represented by our present hydraulic installation of 4,556,266 h.p. has been made the subject of intensive study based largely on the figures of the annual census of hydro-electric central stations. Due allowance being made for all the varying factors entering into the development and use of hydraulic power warrants the statement that a conservative estimate of the capital investment in the Canadian water power industry, including development, transmission and distribution, amounts to over $840,000,000.

Coal Equivalent of Developed Water Power

The development of water power has had a most pronounced effect upon the consumption of coal throughout the Dominion, this being particu-

larly true of the provinces of Ontario and Quebec, where no deposits of native coal are found. It is difficult to assign a precise figure of the coal equivalent of developed water power, as the matter is comparative only, and assumptions must necessarily be made dependent upon the conditions under which the power is developed. However, taking into account all present conditions surrounding water power development in Canada and comparing them with somewhat similar conditions of fuel development elsewhere it is reasonable to state that a saving of coal of six tons per annum is capable of being effected by each installed horse power. This means that the total present water power installation of 4,556,000 h.p. is capable of effecting a saving of about 27,000,000 tons of coal per annum. With the marked economies that are continually taking place in coal consumption in fuel power stations it will be necessary to adjust from time to time the coal equivalent of developed water power, but under existing conditions the figure of 27,000,000 tons is not unreasonable.

This brief review of the water power resources of Canada is sufficient to indicate the very important place they occupy in both the domestic and industrial life of the Dominion. Development during the past few years has been of great magnitude to keep abreast of the ever increasing demand for power and the programme of construction now under way indicates that progress during the next few years will be well sustained. There still remain large undeveloped powers situated within easy transmission distance of the principal centres of population which will ensure the power needs of the country being adequately met for a considerable time to come.

TABLE 1

AVAILABLE AND DEVELOPED WATER POWER IN CANADA January 1, 1927

Province	Available 24-hour power at 80% efficiency		Turbine Installation h. p.
	At Ordinary min. flow h. p.	At Ordinary 6-months h. p.	
1	2	3	4
British Columbia	1,931,142	5,103,460	460,562
Alberta	475,281	1,137,505	34,107
Saskatchewan	513,481	1,087,765	35
Manitoba	3,270,491	5,769,444	227,125
Ontario	4,950,300	6,808,190	1,790,588
Quebec	6,915,244	11,640,052	1,915,443
New Brunswick	50,406	120,807	47,231
Nova Scotia	20,751	128,264	65,702
Prince Edward Island	3,000	5,270	2,274
Yukon and Northwest Territories	125,220	275,250	13,199
Canada	18,255,316	32,075,998	4,556,266

The figures listed in Columns 2 and 3 in the above table represent 24-hr. power and are based upon rapids, falls and power sites of which the actual existent drop or the head possible of concentration is definitely known or at least well established. Many rapids and falls of greater or lesser power capacity are scattered on rivers and streams from coast to coast which are not as yet recorded, and which will only become available for tabulation as more detailed survey work is undertaken and completed. This is particularly true in the more unexplored northern districts. Nor is any consideration given to the power concentrations which are feasible on rivers and streams of gradual gradient, where economic heads may be created by the construction of power dams, excepting only at such points as definite studies have been carried out and the results made matters of record.

The figures in Column 4 represent the actual water wheels installed throughout the Dominion. These figures should not be placed in direct comparison with the available power figures in columns 2 and 3 for the purpose of deducting therefrom the percentage of the available water power resources developed to date. The actual water wheel installation throughout the Dominion averages 30 per cent greater than corresponding maximum available power figures calculated as in Column 3. The figures quoted above, therefore, indicate that the *at present recorded water power resources* of the Dominion will permit of a turbine installation of 41,700,000 horse power. In other words, the present turbine installation represents *slightly less than 11 per cent* of the present recorded water power resources.

The above figures may be said to represent the *minimum water power possibilities* of the Dominion.

As illustrative of this the detailed analyses which have been made of the water power resources of the provinces of New Brunswick and Nova Scotia have disclosed most advantageous reservoir facilities for regulating stream flow and it is estimated that the two provinces possess within their respective borders 200,000 and 300,000 commercial horse power. These figures provide for a diversity factor between installed power and Consumers' demands.

TABLE 2 — DEVELOPED WATER POWER IN CANADA — January 1st, 1927

Province	Turbine Installation in H. P.				Population June 1, 1926	Total Installation per 1,000 population H.P.
	In Central Electric Stations	In Pulp and Paper Mills	In Other Industries	Total		
1	2	3	4	5	6	7
	H.P.	H.P.	H.P.	H.P.		
British Columbia	318,179	80,500	61,883	460,562	568,400	810
Alberta	33,520	......	587	34,107	607,000	56
Saskatchewan	....	......	35	35	823,000	0.04
Manitoba	210,725	......	16,400	227,125	638,000	356
Ontario	1,508,266	174,548	107,774	1,790,588	3,145,600	569
Quebec	1,546,692	242,044	126,707	1,915,443	2,561,800	748
New Brunswick	25,325	13,003	8,403	47,231	407,200	116
Nova Scotia	31,942	16,636	17,124	65,702	540,000	122
Prince Edward Is.	279	......	1,995	2,274	87,000	26
Yukon & Northwest Territory	10,000	......	3,199	13,199	12,300	1,073
Canada	3,685,428	526,731	344,107	4,556,266	9,390,300	485

Column 2 includes only hydro-electric stations which develop power for sale.

Column 3 includes only water power *actually developed* by pulp and paper companies. In addition to this total pulp and paper companies purchase from the hydro power central stations totalled in Column 2, horse power estimated at about 425,000 h.p., including a total of about 951,000 h.p. actually used in the manufacture of pulp and paper.

Column 4 includes only water power *actually developed* in connection with industries other than the central station and pulp and paper industries. These industries also purchase blocks of power from the central stations totalled in Column 2.

Column 5 totals all turbines and water wheels installed in Canada.

Column 6 population at June 1st, 1926, as estimated by the Dominion Bureau of Statistics.

Column 7 averages the developed water power per 1,000 population.

TABLE 3

DEVELOPED WATER POWER IN CANADA
UTILIZED IN THE CENTRAL ELECTRIC STATION INDUSTRY January 1st, 1927

Province	Commercial Stations					Municipal Stations				
	No. of Stations	No. of Turbines	Total Turbine Installation H.P.	Average H.P. per Station	Average H.P. per Turbine	No. of Stations	No. of Turbines	Total Turbine Installation H.P.	Average H.P. per Station	Average H.P per Turbine
British Columbia...	20	47	308,084	15,404	6,555	8	11	10,095	1,262	918
Alberta...........	4	14	32,560	8,140	2,326	1	2	960	960	480
Saskatchewan.....	..	..	....	......	......	..	..	....	......	......
Manitoba.........	3	10	106,400	35,467	10,640	2	17	104,325	52,162	6,137
Ontario...........	76	208	428,675	5,640	2,061	46	133	1,079,591	23,469	8,117
Quebec...........	88	230	1,527,717	17,360	6,642	16	26	18,975	1,186	730
New Brunswick....	5	13	13,915	2,783	1,070	3	6	11,910	3,970	1,985
Nova Scotia.......	9	12	5,099	566	425	14	23	26,843	1,917	1,167
Prince Edward Is..	7	8	279	40	35	..	..	....	......	......
Yukon & North West Territory..	1	2	10,000	10,000	5,000	..	..	....	......	......
Canada..........	213	544	2,432,729	11,421	4,472	90	218	1,252,699	13,919	5,746

Commercial Stations include all privately owned.

Municipal Stations include all publicly owned.

NOTE:—The statistics in this table are based upon a census of the industry made by the Dominion Bureau of Statistics in co-operation with the Dominion Water Power and Reclamation Service.

Public Ownership Pays Large Profits in California

Success of municipally controlled public utilities was seen in a recent report by Ray L. Riley, state controller of California, that not one failure occurred in that state in the operation of municipal enterprises during the last fiscal year.

The municipally owned water and electric systems, operated by 172 California cities, showed net profits of $7,172,542.08, according to the Riley report. Municipally operated water plants in 150 cities alone returned total receipts of $13,696,991.70. Operating expenditures were $7,489,493.11. After the deduction of $3,701,036.66 to provide for bond redemption and interest payments, net receipts of $3,506,461.93 remained. Electric systems operated by 22 municipalities reported total receipts of $12,986,083.33. With deduction of operating expenses and bond and interest payments, a net profit of $3,666,080.15 was had.

Other municipal enterprises which reported profits were gas plants, wharves, docks and landings. The combined profits were $8,509,566.30. —*Power.*

Water Power Situation in Canada

The water-power situation in Canada to-day is one of a record development per capita of total population, of increasing construction work, and of large development in view for many years to come. The continuous statistics compiled by the Dominion Water Power and Reclamation Service of the Department of the Interior show that during the past 10 years the developed water-power has increased at an annual average rate of nearly 6¾ per cent—this however includes the war period when many projects were in abeyance. During 1924 the increase was over 12 per cent and during 1925 over 20 per cent.—*Natural Resources, Canada.*

Hydro News Items

Central Ontario System

The Hinde & Dauch new factory at Trenton is now complete and the Company is preparing to take power for its very up-to-date paper making machinery. The manufacture of paper from wheat straw is an interesting feature of this plant.

* * * *

The existing single phase line to Pickering is being changed to three phase in order to give service to a 50 h.p. power consumer.

* * * *

The village of Foxboro in Hastings County has applied to the Commission for a supply of power.

* * * *

Niagara System

The capacity of the Belle River distributing station has been increased from 150 to 450 kv-a. to take care of the rapidly increasing rural load in this district, the increased capacity being placed in service on April 10th.

* * * *

The new 450 kv-a. 13200–4000 volt station at Woodstock to serve Woodstock Rural Power District was placed in service on May 15th. New office quarters on the main street of Woodstock have been opened for the Rural District.

* * * *

Lansing Rural Power District has been taken over by North York township, area No. 1 being enlarged to include the entire township.

* * * *

Just outside of the village of St. Williams there is a large poultry farm with a considerable acreage that specializes in poultry and fruit. With the extension of rural lines in this district the farm was wired and service taken from the lines of the Walsingham district. In addition to lighting equipment in the residences and barns all the poultry houses are wired. The hatching house is equipped with a 6,000 egg electric incubator. On the first hatch of the season a large increase in the percentage of eggs hatched was shown as compared with other types of incubator, and the management are considering the replacement of their entire equipment by electric incubators.

Experiments are also being carried out in connection with the treatment of the young chicks by the ultra violet ray and it is anticipated an improvement in the stock will result from this treatment.

* * * *

Following construction and placing in service of the line from Burford to the village of Scotland, a creamery, located at Scotland, has made a complete installation of electrical equipment, including a 2-ton ice machine operated by a 5 horsepower motor.

Rideau System

It has been arranged to install a second 3 phase, 750 kv-a. transformer in Smiths Falls station, required due to increase in load.

Electrical Engineering Department Smoker

A very enjoyable evening was spent by over 200 of the Commission's staff and their friends on the occasion of the annual smoking concert arranged by the Electrical Engineering Department and held in the Lecture Room of the Hart House, University of Toronto, on April 20th. The principal item of the entertainment was a farce comedy entitled "A Royal Initiation," being a burlesque in one act showing the tortuous passage of a candidate being initiated into the Distribution Lodge of the Royal Court of Engineering Bunk, which was given by the Distribution Section of the Department. The Hydro Orchestra contributed musical numbers as well as accompaniment for singing. Entertainment by a monologue artist completed the programme. After the concert refreshments were served in the Great Hall.

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in April, 1927.

Appliances

BELLEVILLE ELECTRIC & STAMPINGS LIMITED, Belleville, Ont.

Reflector type Air Heaters, portable type "Redi-Heat."

* * * *

CHAS. A. BRANSTON LIMITED, 126 Wellington St. W., Toronto.

Electric Hair Dryer.

Portable stand and hand type electric Therapeutic Lamps for medical use.

* * * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, 224 Wallace Ave., Toronto.

"Hotpoint" electric cooking ranges.

Cabinet type, manual oven control. Cat. Nos. R26, R26C, R26CH, R26E, R26EC, R26ECH, also left hand in above combinations as R126, etc. Automatic oven control, Cat. Nos. RA26, RA26C, RA26CH, RA26E, RA26EC, RA26ECH, also left hand in above combinations as RA126, etc.

Cabinet type, 110 volts, 7500 watts, manual oven control, Cat. Nos. R27, R27C, R27CH, R27E, R27EC, R27 ECH, also left hand in above combinations as R127, etc. Automatic oven control, Cat. Nos. RA27, RA27C, RA27CH, RA27E, RA27EC, RA27 ECH, also left hand in above combinations as RA127, etc.

Cabinet type, 110 volts, 7700 watts, manual oven control, Cat. Nos.

R17CH, automatic oven control, Cat. Nos. RA17CH, RA18ECH.

Low oven type, 110 volts, 6400 watts, Cat. Nos. R24CH, R24ECH, 110 volts, 7360 watts, Cat. Nos. R25CH, R25ECH; 110 volts, 5360 watts, Cat. Nos. R28, R28C, R28CH; 110 volts, 6260 watts, Cat. Nos. R29, R29C, R29CH; 110 volts, 7160 watts, Cat. Nos. R30, R30C, and R30CH.

Coffee Percolators. Cat. Nos. P1, P2, P3, P11 and P12.

* * * *

General Necessities Corporation, Detroit, Mich.

Automatic electric refrigerator. "Absopure."

* * * *

Thermos Electric Company Limited, Brantford, Ont.

Reflector type air heaters. "Thermo," Cat. No. 61 and 91.

* * * *

Tropical Electrics Limited, 20 Hayter St., Toronto.

Electric air heaters, portable type. "Tropical," Cat. Nos. 6 and 9. Electric Toaster Stove, "Tropical," Cat. No. 5.

* * * *

The Whirldry Corporation, New Haven, Conn.

Electric Washing Machine. "Whirldry."

* * * *

*Fennell System, Inc., Hannibal, Mo.

Cleaning Machines. Model 11, 15 and HC.

* * * *

*Benjamin Electric Mfg. Co., 120-28 S. Sangamon St., Chicago, Ill.

Benjamin Automatic Safety Stand. This device incorporates a thermostatically-controlled switch for controlling the temperature of an ordinary electric flat iron. 660 watts, 250 volts, Cat. No. 9901.

* * * *

*Canadian Kodak Co. Limited (Submittor), Toronto, Ont.

Eastman Kodak Co. (Mfr.), Rochester, N.Y.

Portable motion picture projecting machine for use without fireproof booths. "Kodascope Model A," "Kodascope Model C."

Marking: Nameplate with "Kodascope" model number and rating.

"Eastman" incandescent lamps enclosed in sheet-metal housing and reflectors with colored glass windows to produce diffused illumination in dark rooms of photographic studios. Eastman Safelight Lamp, Wrattan Safelight Lamps, Nos. 1 and 2.

Brownie Safelight Lamps.

Marking: Nameplate with rating.

* * * *

*Magnus Reel Electric Products Corp., 53-57 W. 14th St., New York, N.Y.

Air-cooled transformer—bell-ringing. Cat. No. 200.

Marking: "Magnus."

* * * *

*Tagliabue Mfg. Co., C. G., 18-88 Thirty-Third St., Brooklyn, N.Y.

Temperature Regulating Appliances.

* * * *

*Thermo Electric Instrument Co., 1206 S. Grove St., Irvington, N.J.

Oven consisting of a chamber having a wire-wound heating element regulated by a thermostat. Cat. Nos. 100, 110.

Electrically-heated and thermostatically-controlled incubators. Cat.

Nos. 24, 28, 32, 36, 40. Marking: "Freas."

* * * *

Fittings

HALE BROTHERS, 84 St. Antoine St., Montreal, Que.

Triple Current Taps. Cat. No. 20. Marking: "W."

* * * *

*CARLING TOOL & MACHINE CO., THE, 32 Union Place, Hartford, Conn.

Fuseless attachment plug with switch. Cat. No. 15.

Marking: "Carling."

* * * *

*MAGNUS-REEL ELECTRIC PRODUCTS CORP., 53-57 W. 14th St., New York, N.Y.

Separable and non-separable attachment plugs, Cat. Nos. 1, 22, 32. "Magnus Plugall." Attachment plug for use with portable heating appliances, Cat. Nos. 9, 95.

Marking: "Magnus" and catalog number moulded in body.

Fiber, two-wire type receptacles and fuse plugs. Cat Nos. 305, 315, 330.

Single and double outlet, flush type receptacles for attachment plugs with composition base. Cat. Nos. 161, 162, 171, 172.

Marking: "Magnus."

* * * *

*PASS & SEYMOUR INC., Solvay Station, Syracuse, N.Y.

Separable and non-separable composition attachment plugs, Cat. Nos. 1501-05 incl. Body, Cat. No. 1500. Caps, Cat. Nos. DA, DB, DC, DAP, DBP, DCP, DF, DE. Cat. No. 1232 with pull switch rosette.

Marking: "P. & S."

* * * *

Switches

SMITH AND STONE, LIMITED, Georgetown, Ont.

Plug fuse cutout bases, unfused neutral type, D.P.S.B., D.P., D.B. and 3-2 wire D.B. Cat. Nos. 1201A, 1202A and 1203A.

* * * *

Portable Lighting Devices

LANG BROS. SPECIALTY COMPANY, 43 Britain Street, Toronto.

Portable electric lamps.

* * * *

Miscellaneous

*DALYTE ELECTRIC, LTD., Guelph, Ont.

Armored Cable. Marking: one red and brown cord running longitudinally between conductors and armor or one red and brown thread woven spirally in overall braid covering conductors.

* * * *

*METROPOLITAN ELECTRIC MFG. CO., East Ave. and 14th St., Long Island City, N.Y.

Edison plug fuses. Marking: "Metropolitan."

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover. It would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

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Silver Anniversary of Origin of Hydro

ON the evening of June 9, 1927, the Public Utilities Commission of Kitchener held a banquet to celebrate the twenty-fifth anniversary of the origin of Hydro. It was on June 9, 1902, that the first meeting was held in the city of Kitchener, then Berlin, to discuss the possibilities of power transmission from Niagara Falls to municipalities in the Niagara district. This meeting started the movement which has resulted in the vast hydro-electric enterprise that exists in Ontario to-day.

Mayor Ratz, of Kitchener, welcomed the 150 or more Hydro representatives to "the birth-place of Hydro" and accorded the late Sir James P. Whitney a great measure of credit for backing the late Sir Adam Beck in the initiation of Hydro. Of those who had been present at the first meeting, the following were included amongst the guests : Messrs. A. L. Breithaupt, Geo. Debus, Daniel Hibner, August R. Lang (Chairman, Kitchener Commission), and R. Roschman, all of Kitchener, and J. W. Lyon, of Guelph.

Particular recollection was made to the names of the late D. W. Detweiler and the late E. W. Snyder, both of Waterloo County, who were responsible for calling together that first gathering. Enthusiastic applause greeted the name of Sir Adam Beck, who had appeared on the scene as the champion of Hydro, and in a fight on behalf of the general public put it over the top to its present measure of success.

The speakers of the evening included Brig. General Chas. H. Mitchell, who addressed the original Hydro meeting in Kitchener twenty-five years ago ; J. W. Lyon, of Guelph ; Chas. A. Magrath, Chairman, Hydro-Electric Power Commission of Ontario ; C. A. Maguire, Commissioner, Hydro-Electric Power Commission of Ontario ; T. J. Han-

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nigan, Secretary, Ontario Municipal Electrical Association, and P. W. Ellis, Chairman, Toronto Hydro-Electric System, and Chairman, Toronto Transportation Commission. The speakers recalled the early work of inaugurating Hydro and its progress, and also visualized great possibilities that would be accomplished in the future.

The following municipalities were represented at the banquet: Acton, Aylmer, Brampton, Brantford, Chatham, Clinton, Collingwood, Dundas, Elmira, Etobicoke Township, Fergus, Galt, Guelph, Hamilton, Hespeler, Ingersoll, London, Midland, New Hamburg, Orillia, Oshawa, Paris, Peterboro, Preston, St. Catharines, St. Marys, St. Thomas, Sarnia, Simcoe, Stratford, Tavistock, Toronto, Walkerville, Wallaceburg, Waterloo, Welland, Weston and Windsor.

Mr. C. A. Magrath's Letter of Submittal of the Nineteenth Annual Report

To His Honour

The Honourable William D. Ross
Lieutenant-Governor of Ontario

May It Please Your Honour:

The undersigned has the honour to present to your Honour the Nineteenth Annual Report of the Hydro-Electric Power Commission of Ontario for the fiscal year ending October 31, 1926.

This Report covers all of the Commission's activities and also embodies the financial statements of the municipal electric utilities operating in conjunction with the various systems of the Commission and supplying electrical service to the people of the Province.

Dealing, as it does, with a multiplicity of activities relating to several electrical systems obtaining power from twenty-two hydro-electrical plants operated by the Commission, supplemented by power purchased from other sources, and recording financial and other data relating to the individual local municipal electric utilities, the Annual Report presents a large amount of statistical information, much of which must, of necessity, be of a summary character.

The financial statements, the statistical data and the general informa-

tion given, however, are so arranged and presented as to convey a comprehensive outlook on the features of the Commission's operations. Not only does the Report record the progress made during the past year, but it gives, in addition, the cumulative results for the various periods during which operation has been maintained in the respective municipalities.

During the past year the work of the Hydro-Electric Power Commission has been characterized by steady growth. The generating capacity of the Commission's plants was increased by about 100,000 horsepower, an increase which somewhat exceeds the growth in load during the year, and for the time being has given a reasonable margin between the capacity available and the demand for power. This has resulted in an improved service and enabled the various generating plants to be maintained in a high state of efficiency.

The operation of all the systems has been carried on successfully, and without serious trouble. The class of equipment provided in the Commission's generating plants and on its transmission networks, and the care with which it is maintained and operated have enabled the Commission to provide a remarkable continuity of service. This is indicated by the fact that power was never entirely off the Niagara system for a single minute during the year.

Future supplies of power for the various systems are ever a matter of serious consideration to the Commission. The immediate requirements of the Niagara system have been provided for by contract with the Gatineau Power Company for a supply of power from the Ottawa River watershed. On the Georgian Bay system the continued combined operation of the various generating plants has been very satisfactory and has resulted in an improved service with a margin of power over and above the immediate requirements. The completion of a new storage dam on the Hollow Lake storage reservoir has added substantially to the storage available for the Georgian Bay system. On the Thunder Bay system the Commission has commenced at Alexander Landing a second development on the Nipigon river. On the Central Ontario and Trent system, special attention has been given to the problem of conserving and increasing the flow of streams by the installation of dams and the creation of storage reservoirs.

Cost of Electrical Service Furnished by the Commission

The function of the Commission is not only to use its best endeavours to provide for the people of Ontario, at cost, an adequate and reliable supply of electrical energy, but also to ensure that the cost of that electrical energy to the consumers shall be the minimum consistent with the financial stability of the enterprise. The success that has been attained in the accomplishment of the latter object may be appreciated from the fact that, whereas, according to a recent statement by an accredited authority in the United States,* the average cost of electricity to the domestic consumer in the United States, in 1926, was 7.4 cents per kilowatt hour, the corresponding cost in Ontario, in municipalities served by the Hydro-

Electrical World, New York, Jan. 1, 1927

Electric Power Commission—as shown by the figures given in Statement "D", page 337 of this Report—was, for 1926, less than two cents per kilowatt hour. Statement "D" indicates also that rates for commercial light and industrial power service in Ontario are similarly low.

Respecting the cost to the ultimate consumer of electrical service furnished to Ontario municipalities by the Commission, the following facts are of interest :

More than eighty per cent of the electrical energy utilized for domestic service is sold in municipalities where the average charge to consumers of this class is less than two cents per kilowatt hour.

More than eighty per cent of the electrical energy utilized for commercial light service is sold in municipalities where the average charge to consumers of this class is less than three cents per kilowatt-hour.

More than seventy per cent of the electrical power distributed by municipal systems and utilized for power service is sold in municipalities where the average charge to consumers is less than twenty-five dollars per horsepower per year.

In each of the above cases the consumers' cost quoted is inclusive of all charges.

In considering the low cost of electrical service in Ontario municipalities supplied by the Hydro-Electric Power Commission, attention may be directed to the satisfactory financial status of the local municipal electric utilities as revealed in Statement "A", pages 242 to 281, and in this connection the table on page 234 is of special interest. It shows that no less than fifty-one municipal electric utilities are in the position of being "out of debt"; in other words, their liquid assets such as cash, bonds, accounts receivable, etc., exceed in value their total liabilities, including the debenture balance. Many other municipalities are rapidly approaching this favourable position.

Growth in Load

The following tabulation shows the growth in load in the various systems during the year :

Distribution of Power to Systems 20-Minute Peak Horsepower

system coincident peaks

System	October 1925	December 1925	October 1926	December 1926
Niagara system	683,646	732,306	800,000	809,651
Georgian Bay system	18,261	17,544	17,109	18,191
St. Lawrence system	5,350	5,963	6,790	6,932
Rideau system	2,533	2,654	3,076	3,150
Thunder Bay system	44,086	49,044	40,977	45,640
Ottawa system	14,260	15,617	16,354	17,728
Central Ontario and Trent system	37,762	41,622	41,166	43,901
Nipissing system	2,500	2,693	2,560	2,697
Total	808,398	867,443	928,032	947,890

Financial Summaries

It will be observed that the financial statements embodied in this Report are presented in two main divisions, namely, a division—Section IX—which deals with the operations of the Commission in the generation, transformation and transmission of electrical energy *to the co-operating municipalities*, and a division—Section X—which deals with the various operations of the municipal electric utilities in the localized distribution of electrical energy *to consumers*.

The cumulative results to date of the operation of the several systems of the Commission as set forth in this Report demonstrate a healthy financial condition.

The total investment of the Hydro-Electric Power Commission of Ontario in power undertakings and hydro-electric railways is $203,442,757.99, and the investment of the municipalities in distributing systems and other assets is $74,692,540.69, making in power and hydro-electric railway undertakings a total investment of $278,135,298.68. The total revenue derived from this capital investment aggregated $32,682,653.21 in 1926.

The following statement (No. 1) shows the capital invested in the respective systems and municipal undertakings.

The following statement (No. 2) shows the combined revenue of the Hydro-Electric Power Commission and of the municipal electric utilities.

Revenue of Commission

As usual the Commission is able to report that the revenue obtained from

STATEMENT No. 1,

Capital Invested

Niagara system	$155,769,665.97
Georgian Bay system	5,259,249.53
St. Lawrence system	1,062,444.88
Rideau system	1,161,658.24
Thunder Bay system	12,724,571.03
Ottawa system	46,843.15
Engineering—Power sites, St. Lawrence and Ottawa systems	262,655.18
Central Ontario and Trent system	14,067,963.23
Nipissing system	1,036,000.84
Office and service bldgs., construction plant, inventories, etc.	2,661,806.34
Hydro-electric railways	9,389,899.60
	$203,442,757.99
Municipalities' distributing systems and other assets (exclusive of $8,046,868.53 of municipal sinking fund equity in H.E.P.C. systems)—all systems	74,692,540.69
	$278,135,298.68

STATEMENT No. 2

Revenue

Revenue of Commission from municipal electric utilities and other power customers		$20,555,179.19
Revenue collected by municipal electric utilities		22,677,999.28
Revenue of H.E.P.C. Railways		
Sandwich, Windsor & Amherstburg Ry.	$1,031,443.20	
Guelph District Railways	107,104.19	
Toronto & York Radial Railways	909,079.23	
		2,047,626.62
Total		$45,280,805.09
Deduct amounts included in first item above as follows : H.E.P.C. revenue from sale of power to municipalities, to H.E.P.C. Railways, to Peterborough Railway and to Campbellford Pulp Mill		12,598,151.88
Total Combined Revenue		$32,682,653.21

the consumers has been more than sufficient to meet the full cost of generating and transmitting the electrical energy as well as to provide for all operating expenses and the fixed charges of the municipal utility equipments.

The Commission collected from the municipal utilities and other customers, for power sold, a total sum of $20,555,179.19. This sum was appropriated to meet all the necessary fixed charges and to provide for the expenses of operation and administration. After meeting all charges there was left a net surplus of $565,413.34.

The following statement (No. 3) summarizes the Commission's collections from municipal electric utilities

STATEMENT No. 3

Commissions Collections

Revenue from municipal electric utilities and other power customers		$20,555,179.19
Appropriated as follows :		
Operation, maintenance, administration, interest and other current expenses	$15,693,871.55	
Reserved for sinking fund, renewal of plant and equipment and contingencies	4,295,894.30	
		19,989,765.85
Net surplus, after providing for all expenses and necessary fixed charges, credited to municipalities and shown in their accounts		$565,413.34

and other power customers for the year and shows how the collections have been appropriated.

Rural Electrification

During the past two or three years very substantial progress has been made in Ontario in the field of rural electrification. Practically all rural electrical service is now given through power districts which are operated directly by the Commission. There is now more than $4,000,000 invested in the rural power district systems established by the Commission. Towards this rural work the Ontario Government, pursuant to its policy of promoting the basic industry of agriculture, has, in the form of grants-in-aid, contributed 50 per cent of the costs of transmission lines and equipment, or about $2,000,000. About 2,300 miles of transmission lines have been constructed to date, of which more than 750 miles were approved during the past year, a mileage which exceeds that constructed in any former year. There are now nearly 19,000 customers supplied in the rural power districts.

RURAL POWER DISTRICTS—OPERATIONS FOR YEAR 1926

	Niagara system	Georgian Bay system	St. Lawrence system	Ottawa system	Central Ontario and Trent system	Totals
	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.
Cost of power as provided to be paid under sec. 23 of the Act	228,166.74	8,927.47	4,743.44	1,984.95	10,926.34	254,748.94
Cost of operation, maintenance and administration	162,453.48	6,313.19	1,928.25	3,200.49	6,723.18	180,618.59
Interest	65,991.03	3,474.03	1,759.09	1,453.00	3,398.87	76,076.02
Renewals	54,146.52	2,506.58	1,368.56	1,141.11	2,801.19	61,963.96
Contingencies	13,536.63	626.64	342.13	285.28	695.70	15,486.38
Sinking fund	14,559.51	795.67	373.27	308.96	....	16,037.41
Total expenses	538,853.91	22,643.58	10,514.74	8,373.79	24,545.28	604,931.30
Revenue from customers	664,763.35	25,301.98	12,151.39	8,073.99	32,842.76	743,133.47
Surplus	125,909.44	2,658.40	1,636.65	....	8,297.48	138,501.97
Deficit	....	....	....	299.80	....	299.80
Net surplus	....	....	....	....	....	138,202.17

Municipal Electric Utilities

The following is a summary of the year's operation of the electric utilities of the municipalities which operate under cost contracts with the Commission :

Total revenue collected by the municipal electric utilities...		$22,677,999.28
Cost of power..........................	$12,326,255.18	
Operation, maintenance and administration	4,551,856.16	
Debenture charges and interest..........	3,465,120.44	
Depreciation..........................	1,157,579.05	
Total....................................		21,500,810.83
Surplus for the year, includes surplus from H.E.P.C...		$1,177,188.45

The above covers only the municipalities operating under cost contracts with the Commission.

The consolidated balance sheet of the municipal electric utilities, on page 241, shows a total cash balance of $2,136,290.79, and bonds and other investments of $1,400,316.43. The total surplus in the municipal books now amounts to $20,411,509.32, in addition to a depreciation reserve and sundry other reserves aggregating $10,308,292.50.

Reserves of Commission and Municipal Electric Utilities

The total reserves of the Commission and the municipal electric utilities for sinking fund, renewals, contingencies and insurance purposes amount to $55,471,213.04, made up as follows :

Niagara system....................................	$18,625,079.71
Georgian Bay system................................	1,163,189.74
St. Lawrence system................................	287,539.18
Rideau system......................................	154,504.21
Thunder Bay system.................................	315,590.45
Ottawa system......................................	7,304.95
Central Ontario and Trent system...................	2,134,171.74
Nipissing..	106,744.04
Bonnechere storage.................................	7,217.21
Service buildings and equipment....................	433,473.05
Insurance—Workmen's compensation and staff pension insurance..	1,516,596.94
Total reserves of Commission........................	$24,751,411.22
Total reserves of municipal electric utilities......	30,719,801.82
Total Commission and municipal reserves.............	$55,471,213.04

The Commission has been sensible of the necessity of building up its reserves in order to maintain this important public service on a sound financial basis. During the past six years there have been placed in operation power properties—includ-

ing that of the Toronto Power Company acquired by purchase—that have involved a capital outlay aggregating $133,000,000. As each of these properties came into actual operation supplying power to the systems of the Commission, the process of setting up reserves commenced. It may be pointed out that the reserves of the Commission during the past three years have more than doubled.

* * * *

The following is a brief summary of the principal operations relating to the several systems of the Commission :

Niagara System

The Niagara system embraces all the territory lying between Niagara Falls, Hamilton, and Toronto on the east, and Windsor, Sarnia, and Goderich on the west, served with electrical energy generated at plants on the Niagara river.

There has been a steady increase in the number of consumers supplied on this system, and also in the loads supplied by the Commission to the municipalities. The ninth unit at the Queenston generating station was put into operation in December, 1925.

There are no large power developments under construction by the Commission at the present time to serve the Niagara system and the power supply available from the Niagara river will all be in use about the end of the year 1928. In order to provide for the immediate future demands for power the Commission during the year entered into a long-term contract with the Gatineau Power Company for 260,000 horse-power. Delivery of the first block of this power is to be made about the end of the year 1928. This power will be generated from the Gatineau river in the Province of Quebec, and will be received by the Commission at the inter-provincial boundary on the Ottawa river. It will be transmitted over a 220,000-volt steel-tower transmission line to Toronto where the transmission line will be tied into the Niagara system. In connection with this transmission line, aerial surveys have been carried out during the past year and have greatly facilitated the work of planning the route to be followed by the transmission line. Construction of this line will be commenced during 1927. The power received from the Gatineau river will be 25-cycle power similar to the supply at present given in the Niagara system of the Commission.

The Commission in this system has a total capital investment of $155,769,665.97 and accumulated reserves for renewals, sinking fund and contingencies aggregate $18,625,079.-71. In the rural power districts of this system, which are operated directly by the Commission, the revenue for the year from customers was $664,763.35, and the total cost of supplying the service was $538,-853.91, leaving a balance of $125,-909.44, which is placed to the credit of the districts in this system. The greater part of this surplus is returnable to the users in the form of reduced rates or cash.

With respect to the electric utilities of the municipalities comprising this system, the actual cost of power during the year was $295,317.28 less than the amounts of the interim bills. The

municipal electric utilities operated with a net surplus of $773,037.94 after providing $1,001,261.17 for depreciation. Only three municipalities had actual deficits during the year and these were very small, aggregating $1,842.32. The total revenue of the municipal electric utilities in this system was $19,461,266.84, an increase of $1,554,195.70.

Georgian Bay System

The Georgian Bay system, as now constituted, serves that portion of the province of Ontario which surrounds the southern end of Georgian Bay and lies to the north of the territory served by the Niagara system, the boundary between the two lying south of the municipalities of Lucknow, Wingham, and Orangeville. It includes the district surrounding Lake Simcoe and extends as far north as Huntsville, embracing all of the counties of Bruce, Grey, and Simcoe, and the district of Muskoka, as well as the northern portions of Huron, Wellington and Ontario counties.

The combined generating capacity of the six plants feeding this system approximates 22,000 horsepower inclusive of a frequency changing plant at Mount Forest capable of transferring power both ways between the Georgian Bay and the Niagara systems. One of the generating plants, viz., that at Hanna Chute, was completed and placed in operation during the year.. This new plant consists of one unit rated at 1,550 horsepower under a thirty-foot head and is operated by remote control from the switchboard in the South Falls generating station.

The Commission in this system has a total capital investment of $5,259,249.53 and accumulated reserves for renewals, sinking fund, and contingencies aggregate $1,163,189.74. In the rural power districts of this system, which are operated directly by the Commission, the revenue for the year from customers was $25,301.-98, and the total cost of supplying the service was $22,643.58, leaving a balance of $2,658.40, which is placed to the credit of the districts in this system. The greater part of this surplus is returnable to the users in the form of reduced rates or cash.

With respect to the electric utilities of the municipalities comprising this system the actual cost of power during the year was $101,856.43 less than the amount of the interim bills. The various municipal electric utilities operated with a net surplus of $110,421.37, after providing $44,381.-63 for depreciation. Five small municipalities operated with losses aggregating $1,503.94, whereas the total revenue of the municipal electric utilities of the system was $936,353.17 The year just closed has been the best from a financial standpoint in the history of the Georgian Bay system and marked improvement has taken place in every item of the financial statement.

The St. Lawrence System

The St. Lawrence system serves the district immediately to the north of the St. Lawrence river between Brockville and Cornwall ; the supply of power for the system being purchased from the Cedar Rapids Transmission Company, delivery being made at a point near Cornwall. Service is given to eleven municipalities, six rural power districts and two companies.

The Commission in this system has a total capital investment of $1,062,-444.88 and accumulated reserves for renewals, sinking fund and contingencies aggregate $287,539.18. In the rural power districts of this system, which are operated directly by the Commission, the revenue for the year from customers was $12,151.-39, and the total cost of supplying the service was $10,514.74, leaving a balance of $1,636.65, which is placed to the credit of the districts in this system. The greater part of this surplus is returnable to the users in the form of reduced rates or cash.

With respect to the electric utilities of the municipalities comprising this system, the actual cost of power during the year was $32,365.96 less than the amounts of the interim bills. The municipal electric utilities operated with a net surplus of $47,111.53 after providing $9,891.00 for depreciation. Two municipalities in this system had small deficits aggregating $557.91. The total revenue of the municipal electric utilities in this system was $208,616.51.

Rideau System

The Rideau system serves the district in the vicinity of Smiths Falls, Perth and Carleton Place. Power is available from two generating plants, one at Carleton Place and the other installed by the Commission at High Falls. Both are situated on the Mississippi river. The Commission also purchases power from the Rideau Power Company of Merrickville. The Carleton Place plant was in operation during the past year as a standby. The system supplies five municipalities situated between the Ottawa and St. Lawrence rivers, west of Ottawa.

The Commission in this system has a total capital investment of $1,161,-658.24 and accumulated reserves for renewals, sinking fund and contingencies aggregate $154,504.21.

With respect to the electric utilities of the municipalities comprising this system the actual cost of power during the year was $24,481.39 less than the amounts of the interim bills. The various municipal electric utilities operated with a surplus of $24,632.60 after providing $8,775.00 for depreciation. There were no deficits. The total revenue of the municipal electric utilities in this system was $207,147.-56.

Thunder Bay System

The Thunder Bay system serves the municipalities situated in the district of Thunder Bay at the head of the Great Lakes. Power supply for this system is obtained from the Commission's hydro-electric developments on the Nipigon river, about seventy miles east of Port Arthur. The Cameron Falls generating station is complete with an installation of 75,000 horsepower. Storage works at the outlet of Lake Nipigon regulate the outflow from the lake and the reservoir capacity is sufficient to provide for a complete regulation of the flow.

During the past year the load previously established has been fairly well maintained. Although the actual highest twenty-minute peak established in December on the Thunder Bay system was some 3,000 horsepower less than for the corresponding period during the previous year, due to the fact that in 1925 a large block of power was temporarily and for a short period supplied to the Kaminis-

tiquia Power Company to assist that company on account of low-water conditions, yet the average load for the full period of the year, or the total load sold on the system, was approximately 2,500 horsepower greater than for the previous year. A similar condition existed in the Port Arthur load, the highest December peak established during the year being some 2,200 horsepower less than in 1925, the total average load taken for the entire year, however, being increased by 1,754 horsepower.

Extensive preparation has been made to provide for large increases in power demands for 1927 and 1928, and in a preliminary way for anticipated increase in load up to the year 1932. The construction of the new Alexander development situated one-and-one-half miles below the existing Cameron Falls development on the Nipigon river was begun by the Commission and has progressed favourably during the year.

The city of Fort William, at the beginning of the year, passed by a large majority a money by-law to provide funds for the purpose of constructing a distributing station to handle the power to be taken from the Commission in accordance with its contract—made, in 1917, at the time the decision was being reach to develop power on the Nipigon river—to take power in December, 1927. This station was designed and the construction thereof supervised by the Commission. The Commission has also, during the year, extended its 110,000 volt transmission line to provide service for the city of Fort William and has also constructed a terminal substation adjacent to the municipal substation. Both of these undertakings were completed during the year and will be ready for operation on the date when the city ceases to take power from the private company and becomes a part of the Thunder Bay system. The initial load of the city of Fort William will approximate 8,000 horsepower.

Arrangements were completed during the year by the city of Port Arthur for supplying 15,000 horsepower additional to two existing pulp and paper companies. As the present Cameron Falls development will be fully loaded with the increase in the demand for power during 1927 and 1928, inclusive of the Fort William city load and that of the extensions to the two large pulp and paper mills in Port Arthur, the Commission plans to place the first unit of the Alexander development in operation at the end of 1929.

The Commission, in the Thunder Bay system, has a total capital investment of \$12,724,571.03, and accumulated reserves for renewals and contingencies aggregate \$315,590.45. The total revenue of the municipal electric utilities in this system was \$745,952.-55, and the total revenue collected by the Commission for power sold to municipalities and private companies was \$841,314.59, being \$53,641.60 greater than the total collections from the same customers during 1925.

Ottawa System

The Ottawa system comprises the city of Ottawa and the Nepean rural power district. It receives its power from a hydro-electric development on the Ottawa river adjacent to the city. Power for the Ottawa system is pur-

chased through the Hydro-Electric Power Commission from a private corporation and, therefore, the municipalities of the Ottawa system are not acquiring any equities nor establishing reserves in power generating and transmission systems. It is interesting to note that, although Ottawa enjoys a very low average cost for electrical energy for domestic service, its net surplus after providing $54,242.00 for depreciation was $47,666.47, an amount equal to more than nine-tenths of the revenue received by the electrical utility of the city for the commercial power service it supplied.

Central Ontario and Trent System

The Central Ontario and Trent system serves the district bordering the north shore of Lake Ontario, lying between the territory on the west served by the Niagara and Georgian Bay systems and that on the east served by the St. Lawrence and Rideau systems. The nucleus of this system was the group of properties formerly controlled by the Electric Power Company, Limited, and operated by it through the agency of twenty-two subsidiary companies. These properties were all purchased by the province of Ontario in March 1, 1916, and have been operated by the Commission as trustee for the Province since June 1, 1916. Since that date the system has been greatly enlarged in order to meet the constantly growing needs of the district.

Twelve municipalities, ten of which have been connected to the system since the date of purchase, operate their own distribution systems under contracts with the Commission. These municipalities are grouped in what is termed the Trent system. This system also includes certain rural power districts.

The power supply for the Central Ontario and Trent system is obtained from a number of power developments situated on the Trent and Ottonabee rivers. The power developments were constructed in conjunction with dams required for navigation purposes. During the year investigations respecting the possibilities of the Crow river storage basin for increasing the power supply on the Trent river were continued.

For the purpose of the financial statements the Nipissing system, referred to below, is included with the Central Ontario and Trent system After meeting operating, maintenance and interest charges out of the revenue from the system, the balance remaining was insufficient—by the sum of $8,528.67—to provide the necessary reserves. In view of the fact that the purchase bond issue was refunded at a higher rate of interest (March 1st, 1926), the revenue of the system will be required to provide, in future, additional funds to meet this increase, in addition to a provision for obsolescence and debt retirement.

The total reserves to date provided out of earnings and held specifically for the benefit of the system amount to $2,240,915.78.

Trent System

The twelve municipalities operating their own distribution systems under cost contracts with the Commission in the district known as the Central Ontario and Trent system have been grouped under the above heading They are served with energy from,

and are considered as customers of, the Central Ontario and Trent system. Their combined operation for the year shows a net surplus of $70,844.03, after providing $30,549.95 for depreciation. There were no deficits.

Nipissing System.

This system comprises the city of North Bay, the town of Powassan and the villages of Callander and Nipissing, and was acquired by the Province in 1916, at the same time as was the Central Ontario system peıty the records of which on the Commission's books include the Nipissing system. The Nipissing system is supplied with power from two hydro-electric developments on the South river, at Nipissing and Bingham Chute.

The franchise of the private company which served the city of North Bay prior to the acquisition by the Province of the Nipissing system, along with the other property of the Central Ontario system, expired at the end of 1926. The Commission has carried on the operation of the North Bay system in accordance with this franchise until the present time and, during the year, has investigated the future operation and discussed the matter with the municipal authorities concerned. It is expected that during the coming year a decision will be reached which will be satisfactory to all parties.

The Annual Report.

The Table of Contents, pages xvii and xviii, conveys a good understanding of the scope of the matters dealt with in the Report, to which there is also a comprehensive Index. To those not conversant with the Commission's Reports the following notes will be useful.

In Section II, pages 9 to 55, dealing with the Operation of the Systems, are a number of interesting diagrams showing, graphically, the increase in the loads on the various systems. Tables are also presented showing the amounts of power taken by the various municipalities during the past three years.

The rural distribution work of the Commission has proved of widespread interest and special reference to this is made in Section III on pages 70 to 75. The power distributed to rural districts is, and probably must always be, but a relatively small proportion of the power distributed by the Commission. The supplying of electrical service in rural areas, and especially on the farm, has, however, been of great economic benefit to Ontario. The Provincial grants-in-aid to this work have been of assistance to agricultural activities, and have enabled the Commission to extend transmission lines to many areas which could not otherwise have received the benefits of electrical service.

In Sections IV, V and VI will be found information respecting progress of work on new power developments and on transmission system extensions, together with photographic illustrations.

About two-thirds of the Report is devoted to statistical, financial data which are presented in two Sections, IX and X.

Section IX presents in summary form the fiancial statements relating to the operations of the Commission in the generation, transformation and

transmission of electrical energy to the co-operating municipalities. It is introduced by an important explanatory statement which appears on pages 123 to 127, to which special reference should be made.

Section X presents in summary form the financial statements relating to the operations of the municipalities in the localized distribution of electrical energy to consumers. It also contains details of the costs of electrical energy to consumers in the various municipalities and tabular statements of the rates in force which have produced these costs. An explanation of the various tables and statements is given at the commencement of this Section on pages 231 to 235 ; and a special introduction to Statement "D," which relates to the cost of electrical service in Ontario, together with a diagram, appears on pages 338 and 339.

The aim of the Commission is to give in its Annual Report the fullest details respecting the activities of the whole undertaking. The various electrical systems are being operated for the benefit of the people, with the Commission as the central co-ordinating trustee acting for the municipalities who have combined to work their electrical properties in co-operation.

Because of the fact that in so short a period it has come into control of practically the entire electrical services of the more settled areas of this vast Province, the Commission realizes that, from time to time, some controversial issues must inevitably arise in one community or another. It is, however, remarkable how seldom such issues do arise. Moreover, the Commission, from actual experience, is able to state that these local difficulties can always be adjusted, even though at times the adjustment cannot be brought about as quickly as desired. It is largely a question of sincere co-operation, and in this connection I have much pleasure on behalf of my colleagues and myself in expressing to the Press of the Province, as well as to the various co-operating municipal bodies, gratitude for the generous support we have enjoyed.

Finally, I would recall that the Commission's business is not only to supply power at cost, but at as low a cost as is consistent with the maintenance of a highly efficient equipment and the provision of proper safeguards in the way of reserves. This can be accomplished only through the exercise by the various members of our organizations of the closest supervision over their respective activities. It is their function to reduce waste to a minimum and to be continually on the alert to obtain better results. I should like to take this opportunity of expressing the warm appreciation the Commission entertains for the loyal co-operation of its staff and for the good-will displayed by those associated with other organizations which have co-operated in furthering matters with which the Commission has had to deal.

For the success of such an organization as the Hydro-Electric Power Commission, the establishment of the most complete confidence is a vital essential. This implies the light of publicity. To this end the information in the following pages has been

compiled and published, and it is confidently believed that the facts recorded in this Report justify the whole-hearted support which is being extended to this great enterprise.

Respectfully submitted,

CHARLES A. MAGRATH,
Chairman.

Boy Burned When Kite Wire Hits Hydro-Electric Line

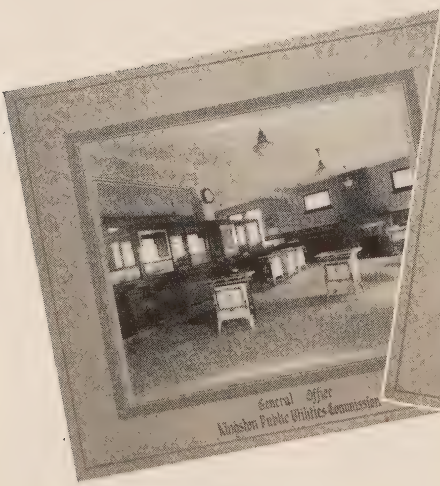
Walter Douse, 15, of 332 St. Luke Road, Ford City, almost lost his life this morning when the copper thread he was using as a kite string became entangled in a high tension Hydro wire near his home. He sustained minor burns to his hands and feet, but it is believed that he would have been electrocuted had not the contact melted the kite wire.

Hydro officials stated after the accident that the high tension wire carried 26,000 volts, and that only the size of the kite thread saved the young lad from instant death. As it was, the shock he received was considerable, burning his right hand and one of his right toes as it passed through his body. If the kite wire had been a little thicker, it would not have melted so quickly, and the shock would have been fatal.

As a direct consequence of this accident, Chief Albert Maisonville, of the Ford police department, issued an order this morning that wires must not be used in future for the flying of kites in the town.

"A few months ago," the chief said in issuing the order, "a young man was electrocuted in the Border Cities while fastening a radio aerial to a Hydro pole. We are going to take steps to prevent a tragedy of that kind from happening again."

Young Douse was allowed to return to his home after his burns were treated.—*The Border Cities Star.*



Our Radio Stations

THE advances in radio to greater reliability in the completed apparatus and renewal parts have led many power companies to install radio equipment to provide additional channels for communication and a system for use in emergencies when the physical telephone is out of commission.

The feature of radio that it is not dependent upon the comparatively frail telephone lines, but may be used either along the more rugged power lines, or independently of any lines, is one of the chief features recommending its use. In addition it does not suffer from some of the sources of trouble which cause disruption of the telephone service.

Radio may be used in any of three ways :

(*a*) *Broadcast Stations*—where the energy is radiated from an aerial and is propagated through space in all directions, being receivable at any point within range.

(*b*) *Guided Radio*—where the aerial is placed in close proximity to power lines, and the greater part of the energy is guided along the lines to the receiving stations where other aerials, also close to the lines, collect a part of the energy and lead it to the radio receiver.

(*c*) *Carrier Current*—where there are no aerials but the high frequency equipment is coupled to power lines through suitably insulated fixed condensers.

The Commission uses all of these systems and at the present time owns and operates twenty-six complete radio transmitting and receiving stations, with two more stations under construction, and in addition assists in the maintenance of three stations which are installed on the 13,200-volt lines of one of the municipalities on the Niagara system.

These thirty-one stations have all been designed by the engineers at the Commission's Laboratories in Toronto and installed under their supervision.

The stations are divided on the power systems as follows :

(*a*) Niagara system—
 Broadcasting Stations—8.
 Guided Radio Stations—16.

(*b*) Municipal—
 Guided Radio Stations—3.

(*c*) Thunder Bay system—
 Broadcasting Stations—2.
 Guided Radio Stations—2.

These radio stations are used only for the operation of the power systems, and do not broadcast musical programmes nor handle messages for the general public, although the designs of the stations are such that they could easily be used for either purpose.

NIAGARA SYSTEM

Broadcast Stations

The first radio stations to be installed on the lines which now comprise the Niagara system, were the five stations on the Toronto Power Company's system. These were located at Niagara, Toronto, Burlington, Port Credit and Silverdale, and commenced operation in 1922, using the wave length of 1650 metres. The wave length was later shortened to 510 metres.

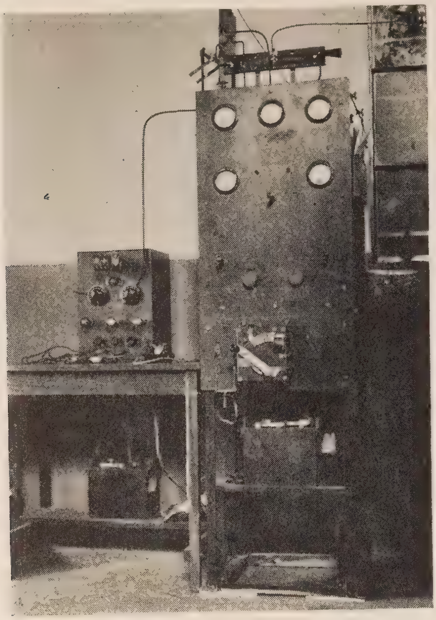


Fig. 1. Broadcast Radio Transmitter and Receiver Installation.

In 1923, the Commission installed four more broadcasting stations located at Toronto, Dundas, London and Walkerville Junction, and these commenced operation on the wave length of 1570 metres, but this wave length was soon shortened to 960 metres.

Quite recently, however, the station at Port Credit has been dismantled and the remaining eight broadcast stations have been adjusted to the one wave length of 560 metres. These stations are now quite close to the broadcast band of wave lengths and should be received by many broadcast listeners near the top of their range.

In Fig. 1 may be seen the broadcast transmitter and receiver installed in one of these eight stations. With the exception of the small set at Silverdale, these stations are all about the same in design. They differ in power, however, for the stations at Niagara, Burlington and Toronto (Davenport Road) are rated at 50 watts output whereas those at Toronto (Strachan Avenue), Dundas, London, and Walkerville Junction are rated at 125 watts output. The station at Silverdale is rated at 5 watts.

In Figs 2 and 3 are shown typical aerials used with these broadcast sets.

Guided Radio Stations

On the Niagara system there are also sixteen low-power guided radio stations which use the 110 kv. 25 cycle power lines as the medium to carry the radio waves from station to station. The aerials are run between the towers near to the power lines—in some cases above the lines and in other cases through among the lines or below—and this system is much more efficient than broadcasting and also more private, but may be interrupted where the power lines are broken or completely grounded.

These stations were started early in 1923 on the wave length of 1570 metres and are still using the same wave length.

Two types of transmitters are used in the guided radio stations, namely, the single tube type shown in Fig. 4 and the two tube type in Fig. 5. In either type the power rating is · nly 5 watts, but the sets are very efficient and excellent results are obtained over the different sections of the system.

The receivers have one stage of audio frequency amplification, and are limited in their range, not being

Fig. 2. Broadcast Aerial at Dundas Station.

Fig. 3. Broadcast Aerial at Silverdale Station.

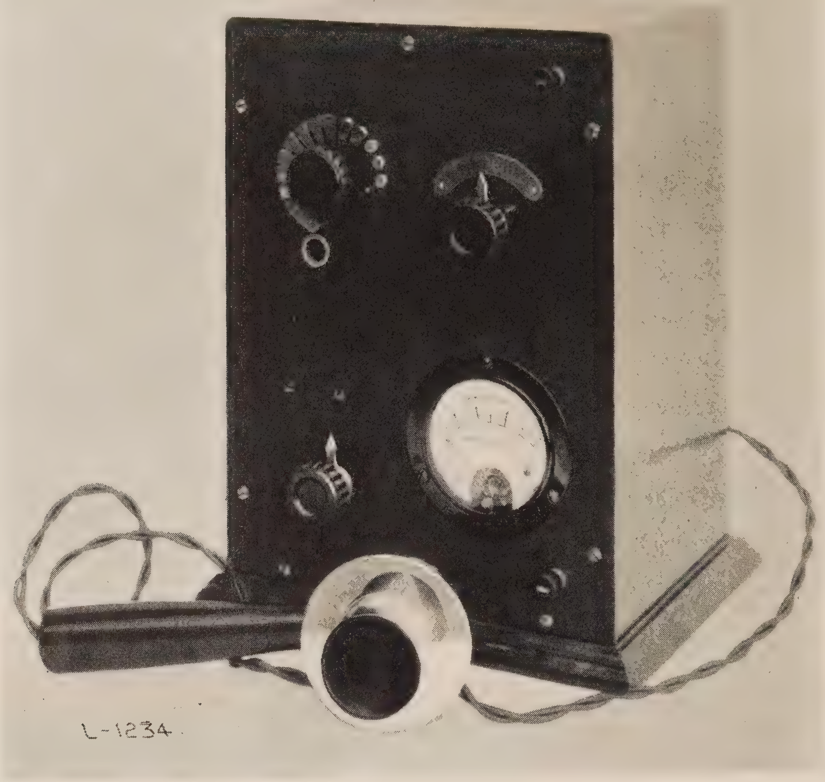


Fig. 4. Single Tube Guided Radio Transmitter.

adaptable to receiving the broadcast wave lengths, but capable of being tuned to receive time signals direct from the Arlington Radio Station.

Operation

Each installation, whether a broadcast station or guided radio station consists of a suitable aerial, one transmitter and receiver, with the necessary high voltage generator, batteries, switches and other parts. The transmit-receive switch makes all changes necessary in the connections to transfer from "transmitting" to "receiving," and there is no provision for duplex, or two-way, communication as this is not required ; the stations transmit and receive by voice in turn.

Since all of the stations on the Niagara system are installed primarily for use in cases of emergency, *e.g.*, when there is a power interruption—it is essential that the sets be not dependent upon the alternating current supply ; they must be run from a source of power which is not subject to interruptions. Storage batteries, therefore, are used for power supply for driving the generators and for lighting the filaments of all tubes.

Fig. 5. Two Tube Guided Radio Transmitter.

The more powerful equipment is installed in transformer stations which are equipped with 110 volt station storage batteries, but where these are not available, as in some of the guided radio stations, automobile and glass jar type storage batteries are used.

Serious interference is experienced from the charging of lightning arresters, static discharges on insulators, and other transients on the power lines, but the most severe interference occurs when the lines suffer from sleet.

Operation in Emergency

On March 31, 1926, a severe sleet storm loaded the lines of the Niagara system with ice, and completely interrupted telephone communication between all transformer stations east of London. In this emergency, seventeen of these radio stations were called into service and the Niagara systems were operated by means of these sets for a period of three days. During this period the radio sets served for transmission of all operating and other instructions and of system reports.

This is, perhaps, the first instance where so many radio stations have been used in a practical manner to give a connected service under such severe conditions. In this case, as usual, all of the radio equipment was operated by the regular station operators on pre-arranged schedules, and proved quite equal to the emergency.

MUNICIPAL GUIDED RADIO STATION

Guided Radio Stations

In May, 1925, the Public Utilities Commission of London, installed three low-power guided radio stations on its 13,200-volt power lines within the municipality.

The equipment had been built by a local manufacturer under the supervision of the laboratory engineers and was installed in the Springbank, Horton and Cabell Stations.

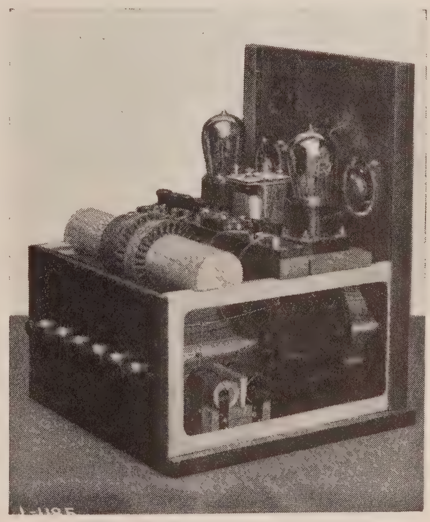


Fig. 6. Guided Radio Receivers Niagara System.

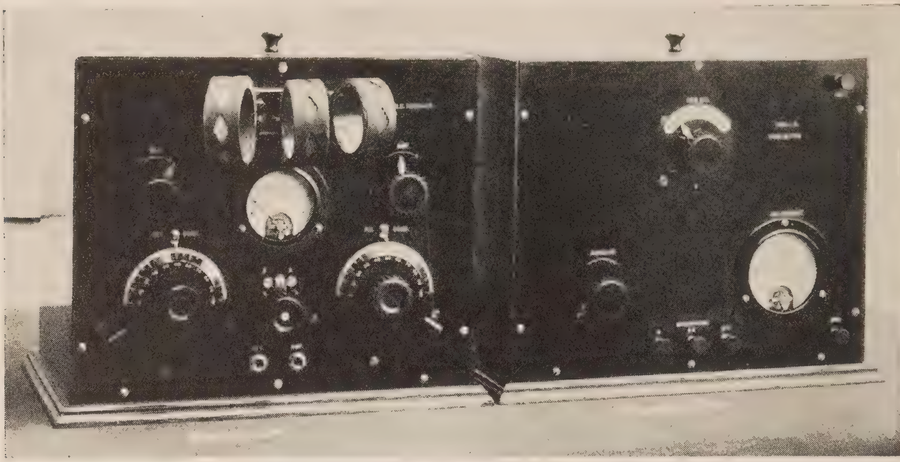


Fig. 7. Guided Radio Receiver and Transmitter, Public Utilities Commission, London.

This equipment forms a very neat installation (Fig. 7), and is very efficient in operation over the short distances between stations. These stations use the wave length of 1150 metres.

A unique feature of one of these installations is the method used to by-pass about ¼ mile of underground cable by means of an artificial overhead line.

The Public Utilities Commission relies upon the laboratories and the regular radio maintenance staff to take care of the special maintenance on this equipment, but operates the

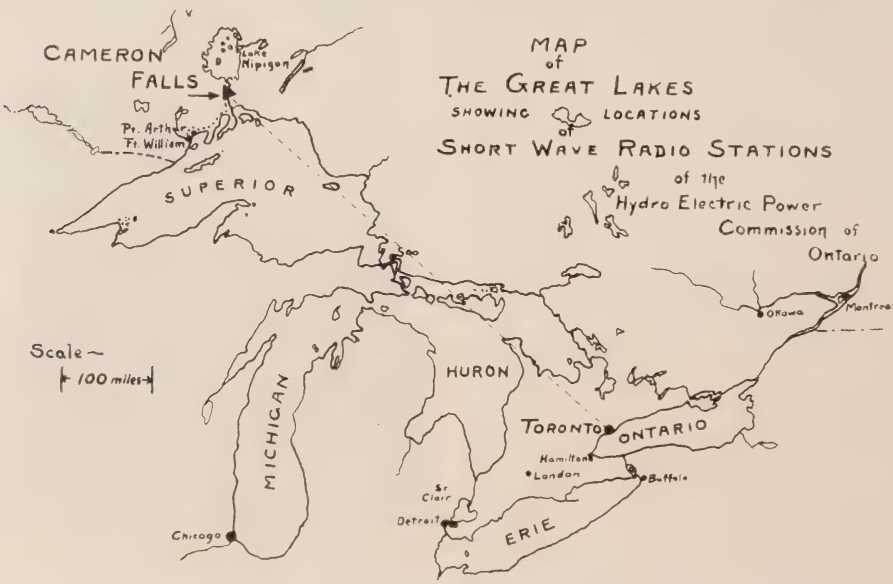


Fig. 8. Map of the Great Lakes.

stations and makes minor repairs and adjustments by its own operating staff.

Thunder Bay System

Short Wave Broadcast Stations

The generating station of the Thunder Bay system is at Cameron Falls on the Nipigon river. It is essential that the administrative offices in Toronto be kept in close touch with the operations of this system, so to provide a ready means of communication, two short wave radio code stations were installed in August, 1926.

The direct distance between Toronto and Cameron Falls is approximately 580 miles. (Fig. 8.)

On account of the peculiar behaviour of short waves in travel, namely, the skip distances and their variation according to the hours of the day—it was necessary to have two wave lengths assigned for this service. Daylight transmission is carried out on the wave length of 29.94 metres,

Fig. 9. Short Wave Aerial—Toronto

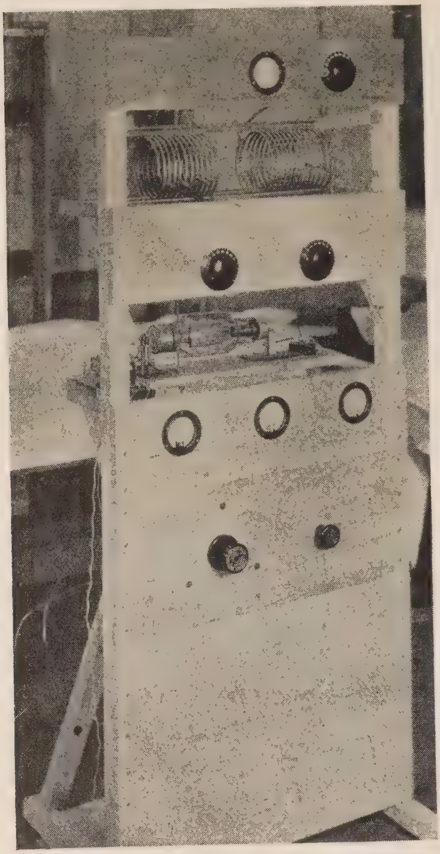


Fig. 10. Short Wave Transmitter—Front

whereas all communication at night is done at 50.0 metres.

The station at Toronto is located on the sixth floor of the Administration Building with an aerial supported by a mast on the roof. (Fig. 9.) At Cameron Falls, the equipment is installed in a small building with a vertical mast in the rear to support the aerial.

The transmitters are typical short wave equipment as showm in Figs. 10 and 11. The panels are of maple impregnated with paraffin and the inductances are supported on glass rods. At each station, only one tube is used for transmission, *i.e.*, type U.V. 204A, and in usual transmissions about 200 watts input to the tubes is required to give satisfactory signal strength at the receiving end.

A special keying system is used in these transmitters to prevent interference with local broadcast listeners. The keying is accomplished by a small variation of wave length, without change in magnitude of aerial current, and apparently is not causing any interference for there have not yet been any complaints received.

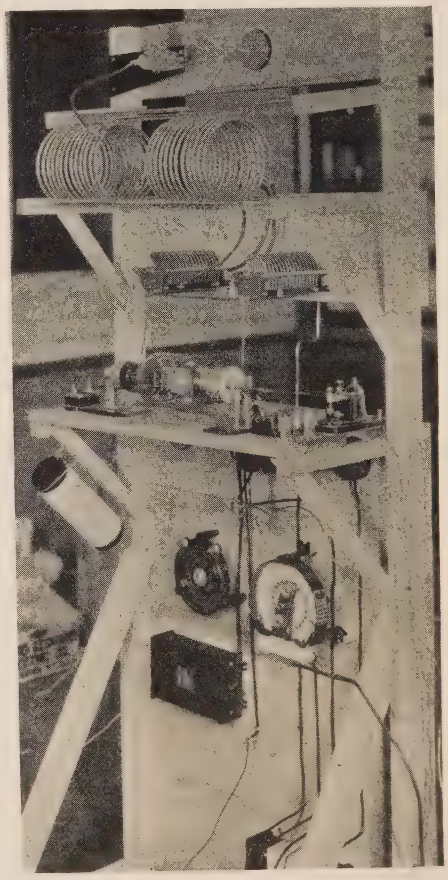


Fig. 11. Short Wave Transmitter—Rear.

The receivers use only one stage of audio-frequency amplification, two tubes, and are of very simple design. (Fig. 12.)

These stations work with each other on prearranged schedules, calling in the usual way, and handling messages relating to operation of the power system, to additional construction, or to the electrical affairs of the municipalities on this system, but are not used for regular public commercial service.

Guided Radio Stations

The equipment for two guided radio stations for the Thunder Bay system is now under construction. These stations will be located at Cameron Falls Generating Station, and at Bare Point Transformer Station, about 4 miles east of Port Arthur.

The aerials will be similar in design to those used on the Niagara system, but the transmitters are a departure from previous designs. They are of the two-tube type with 50-watt rating, and will receive power from station storage batteries through three-unit motor-generator sets.

The receivers are duplicates of those in use at the stations of the

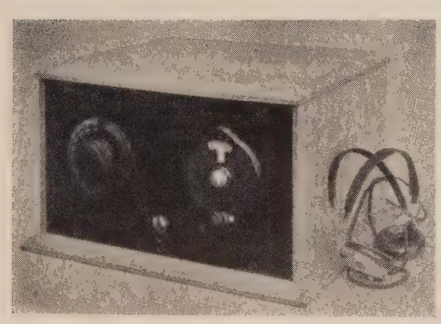


Fig. 12. Short Wave Receiver.

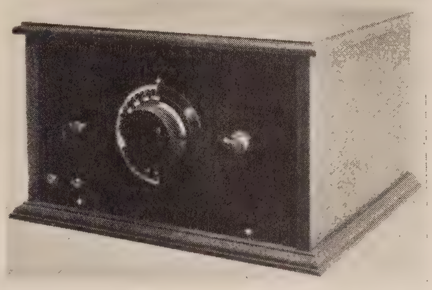


Fig. 13. Long Wave Receiver.

Public Utilities Commission at London, as shown at the left in Fig. 7.

This equipment will provide a communication channel along the 110 kv. 60-cycle lines over a distance of about 70 miles. The call letters of these two stations are now assigned, and it is probable that they will operate on the wave-length of 1,305 metres.

TIME SIGNAL RECEIVING STATIONS

A self-contained long wave receiver has been developed recently for the purpose of obtaining the time signals direct from the United States Naval Radio Station at Arlington, Va. Receiving Stations for this service have been established at the operating centres of four of the Commission's power systems, namely, Toronto (Administration Building), Belleville, Waubaushene and Cameron Falls.

These receivers are as simple in design as possible, consistent with the necessary selectivity and volume control. Dry cell tubes are used to simplify the battery maintenance, and all batteries are contained within the cabinet. (Fig. 13.)

On the panel appear only the condenser dial, the filament switch at the right and the regeneration control at

the left, with jacks for the headphone cord tips.

On the Niagara system, time signals are received by the broadcast station at Dundas and distributed over the entire system on the private telephone lines.

Call Letters and Wave Lengths of Transmitting Stations

The following is a list of call letters and wave lengths of the stations previously mentioned :

General Application of Radio

In addition to the establishing of radio stations on the power systems, the Commission has been interested in more general applications and studies of radio problems, a few of which are mentioned in following paragraphs.

Rules and Regulations

In June, 1924, the Commission issued the Seventh Edition of Rules

(a) Niagara System

Location.	*Call Letters*	*Wave Lengths*
Brant (near Brantford)	GD	1570
Burlington	FO.	560
Cooksville	FV	1570
Dundas	GJ	560–1570
Essex (at Walkerville Jct.)	GL	560–1570
Guelph	FX	1570
Kent (near Chatham)	GG	1570
Kitchener	FZ	1570
London	GK	560–1570
Niagara	FK	560
"	GH	1570
Preston	FY	1570
Queenston	FW	1570
Silverdale	FL	560
Stratford	GA	1570
St. Marys	GC	1570
St. Thomas	GF	1570
Toronto (Davenport Road)	FN	560
" (Strachan Avenue)	GI	560–1570
Woodstock	GE	1570

(b) Public Utilities Commission, London

Cabell Station	GW	1150
Horton Station	GU	1150
Springbank Station	GV	1150

(c) Thunder Bay System

Bare Point (near Pt. Arthur)	FQ	1305
Toronto	9AI	29.94–50.0
Cameron Falls	9AQ	29.94–50.0
" "	FP	1305

and Regulations covering electrical installations for buildings, structures and premises, and in that issue, on page 91, are to be found new rules governing radio installations in the Province. These are included because radio receiving and transmitting sets, particularly the former, are being installed in such large numbers that the adoption of certain rules and regulations designed to protect life and property has become imperative.

The Commission also is represented on the Radio Sub-Committee of the Canadian Engineering Standards Association, The purpose of this subcommittee is to prepare general specifications and regulations to be applied to radio installations throughout Canada.

Recording Time Signals

In January, 1925, the broadcast station at Toronto was used to record the time signals from Arlington, Va., for the purpose of checking a speed recording instrument at the laboratories. A sound resonator was used in these experiments to suppress static and a very satisfactory tape of the time signals obtained. (Fig. 14.)

Lightning Accident

During the summer of 1925, the laboratories had the opportunity of investigating a very rare case where lightning struck a radio aerial and destroyed a large dwelling with only very little damage to the radio receiver. The study of this accident was particularly valuable in supplying a large amount of information on the behaviour of severe lightning strokes. It is seldom that so good an opportunity has been afforded for studying the effect of lightning in such great detail.

REFERENCES

In the preceding paragraphs, it has been possible to give only a very brief outline of the activities of the Commission in radio, but articles have appeared in earlier issues of the BULLETIN which describe in much more detail the radio stations and other associated matters.

The following list of references to these articles has been prepared for the benefit of any readers who would be interested in obtaining further information.

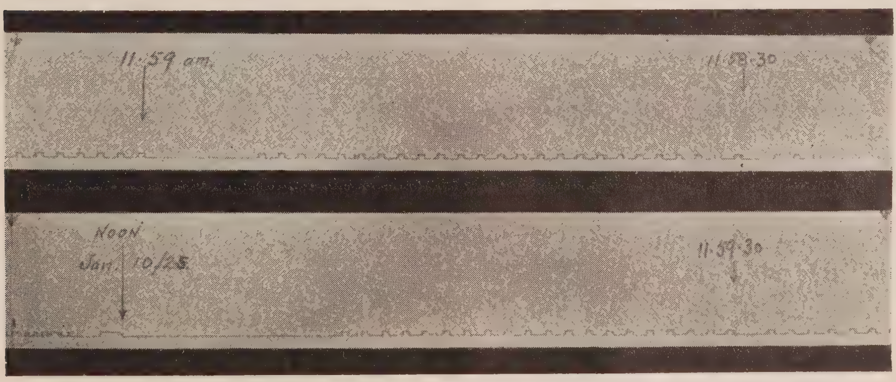


Fig. 14. Tape Record of Arlington Time Signals (Read right to left).

"Emergency Communication by Guided Radio Telephone"—p. 183, June, 1923.
"Measurement of Radio Aerial Capacity"—p. 20, January, 1924.
"Emergency Communication by Radio Telephone Broadcasting"—p. 138, April, 1925.
"Recording Arlington Time Signals"—p. 143, April, 1925.
"Municipal Emergency Radio" (London), p. 217, June, 1925.
"Lightning Strikes Radio Aerial"—p. 337, September, 1925.
"Radio vs. Sleet"—p. 120, April, 1926.
"Toronto to Cameron Falls, by Radio"—p. 327, October, 1926.
"High Frequencies and Short Radio Waves"—p. 351, November, 1926.
"Arlington—Our Standard of Time"—p. 397, December, 1926.

Experimental Electrical Shock

By R. W. Ian Urquhart, M.A., M.B., Laboratory of Physiology, University of Toronto

(Extract from The Journal of Industrial Hygiene, Vol. IX, No. 4, April, 1927.)

(Continued from May Number)

Graphic Records

Graphic records of the carotid blood pressure and of the respiratory movements were taken in most of the experiments throughout this work. The curve of the blood pressure during and following application of the current may be divided into several phases. These are shown in Chart 1, in which the time is also indicated in one-second intervals. The abscissa is indicated on each chart. We shall discuss first the general behavior of the tracing in each group of experiments and then consider the causal factor for each of the phases.

Chart 1 (that of rabbit 61) is typical of the group in which spontaneous respiration took place following the passage of the current. After applying the smaller electrode (0.1 sq. cm.) to the exposed atloido-occipital membrane, 500 milliamperes were given for two seconds. During that time(phase 1) the animal was in a general tonic convulsion and the heart was stopped. When the current was broken, complete muscular relaxation followed and the blood pressure fell momentarily (phase 2) and then rose rapidly to about twice its normal height (phase 3). During the rise two or three irregular beats of the heart can be made out in the tracing, but at the peak they suddenly change to a rapid, regular rhythm. The blood pressure soon fell again until it stood at about one-half the normal level (phase 4), at which it remained for about five seconds, when a slight rise again occurred (probably due to asphyxia). After about one and a quarter to two minutes, the deep indentations which mark the return of gasping respirations became evident on the curve (phase 5), and as these became more regular the blood pressure gradually returned to about its normal level.

Chart 2 (rabbit 77) is typical of those experiments in which a fatal amount of current was used without any attempt at resuscitation. The animal received 1,100 milliamperes for two seconds through the larger electrode (area 0.36 sq. cm.) applied

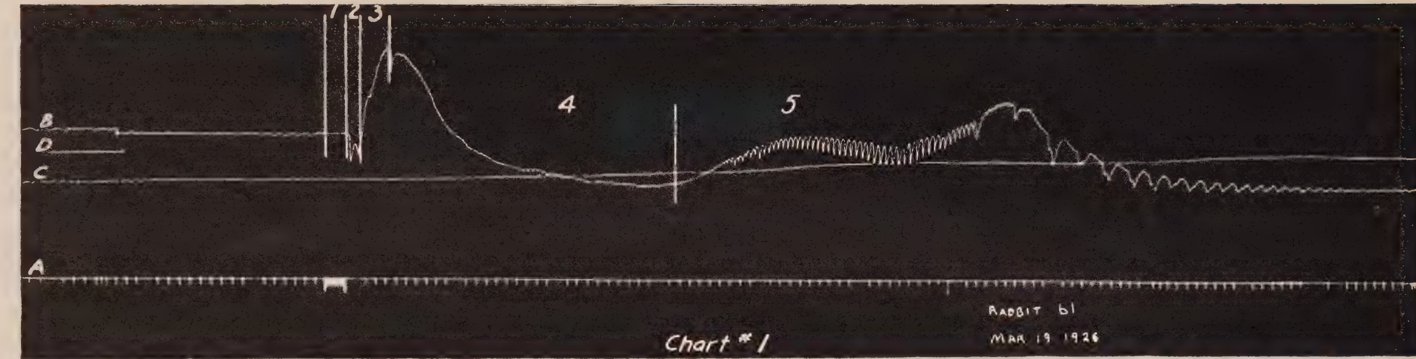


Chart 1.—Rabbit 61. Showing recovery of animal without artificial respiration. Electrodes on the atloido-occipital membrane and in the nose. Current 500 milliamperes for two seconds.
A—time and blood pressure base line. B, C, and D — first, second, and third lines of tracing. The tracings are taken on a circular drum so that line B is continuous with line C, and so on.
The parallel vertical lines indicate the phases into which the tracings have been divided as described in the context. The blocked-out portion of the time and blood pressure base line indicates the time of the passage of the electric current.

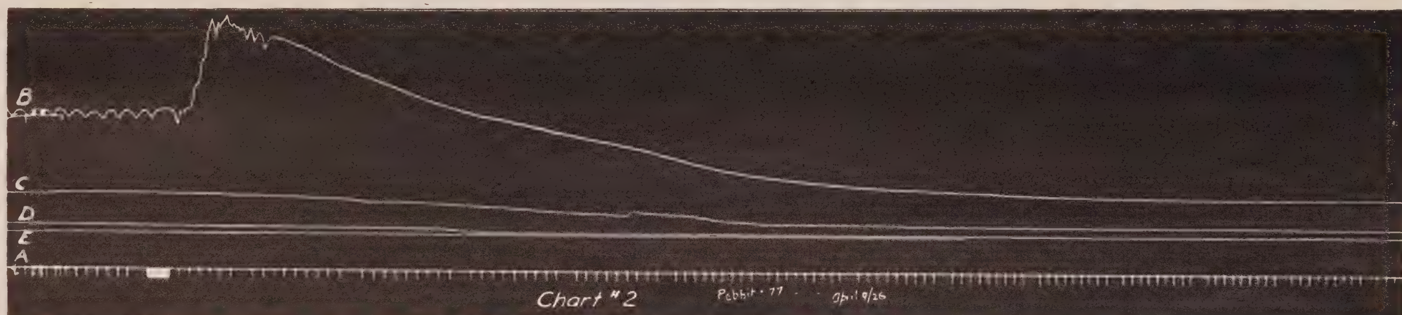


Chart 2.—Rabbit 77. Showing death of animal when artificial respiration is not applied. Electrodes on the atloido-occipital membrane and in the nose. Current 1,100 milliamperes for two seconds.
A — time and blood pressure base line. B, C, D, and E — first, second, third, and fourth lines of tracing.

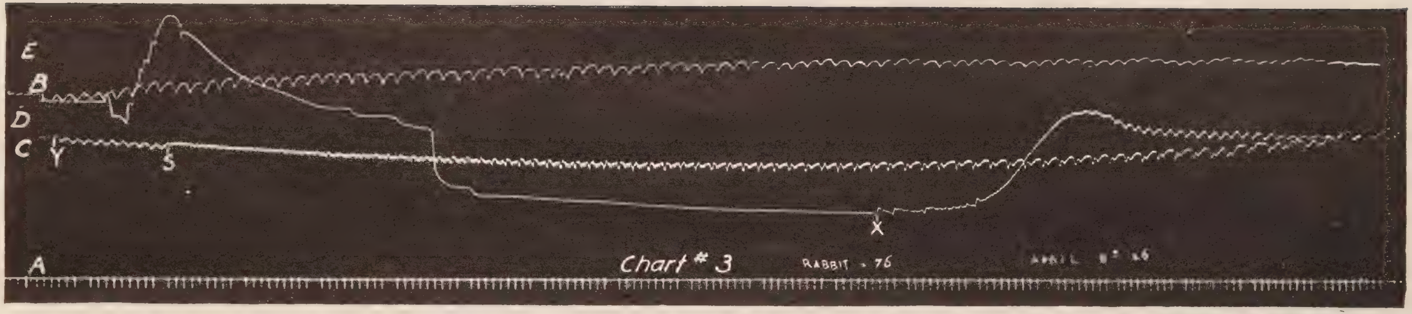


Chart 3.—*Rabbit 76. Return of normal respiration following the application of artificial respiration in an animal receiving a lethal dose. Electrodes on the atloido-occipital membrane and in the nose. Current 1,200 milliamperes for two seconds.*
A, B, C, D, and E as in previous charts. X — application of artificial respiration. Y — return of the animal's own respiration. S — artificial respiration discontinued.
Note.—The usual rapid fall in blood pressure (phase 4) in this chart is distorted by a momentary twist in the carotid cannulas.

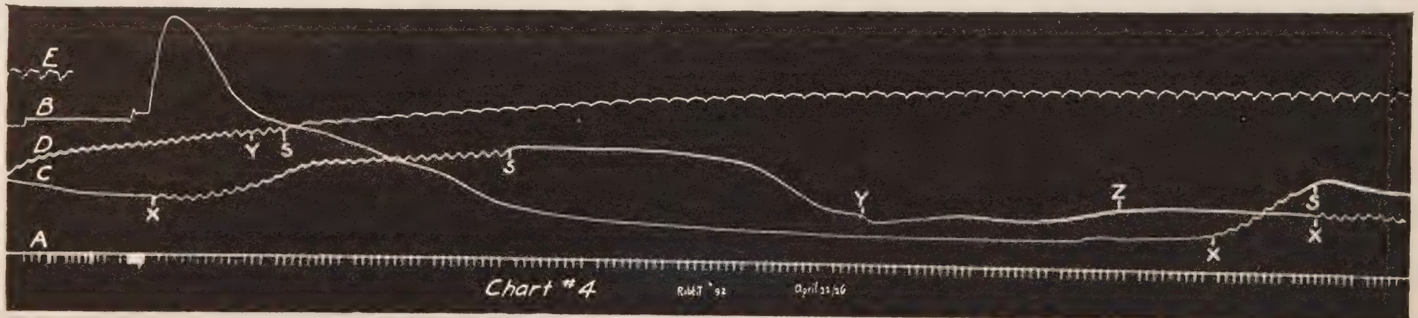


Chart 4.—*Rabbit 92. The effect on resuscitation of interruptions in the application of artificial respiration in an animal showing ultimate recovery. Electrodes on the atloido-occipital membrane and in the nose. Current 800 milliamperes for two seconds.*
A, B, C, D, and E as in previous charts. X, Y, and S as in Chart 3. Z — failure of animal's own respiration.

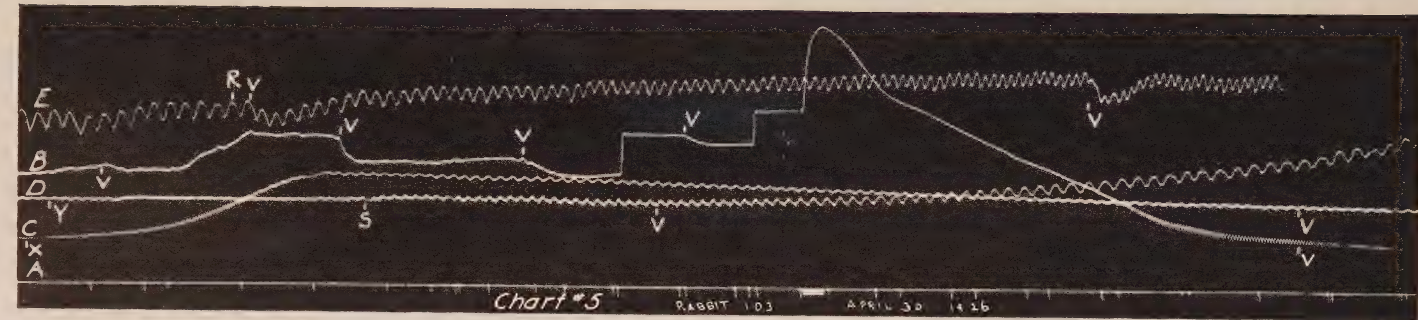


Chart 5.—Rabbit 103. Demonstrating the presence of a block in the centers following the application of an electric current. Electrodes on the atloido-occipital membrane and in the nose. Current 700 milliamperes for two seconds.
A, B, C, D, and E as in previous charts. X, Y, Z, and S as in previous charts. V — stimulation of the central end of the cut vagus. R — return of eye reflex.
Note.—The reflex response to stimulation of the central end of the cut vagus is absent following the passage of the current. After a period of approximately eight minutes during which artificial respiration was applied and the respiratory center became active, this reflex returns, and for the first time an eye reflex can be obtained.

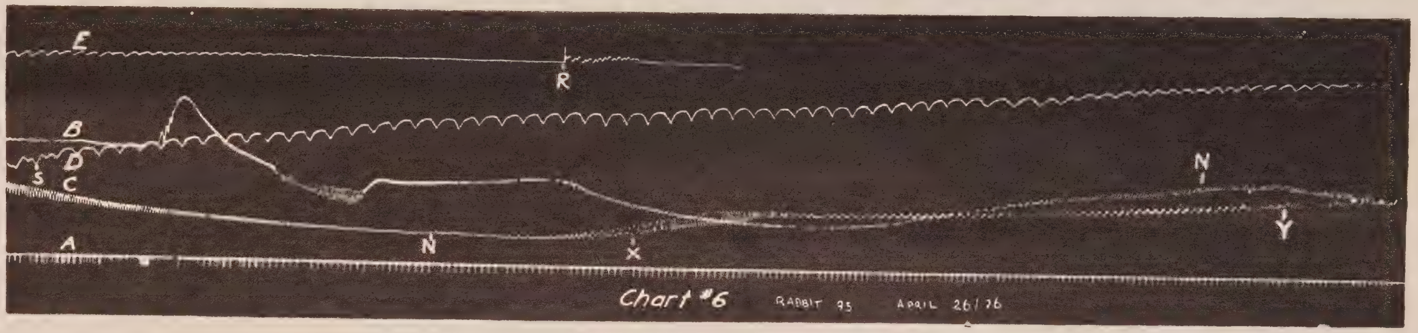


Chart 6.—Rabbit 95. Demonstrating that stimulation of afferent nerves has no influence on the recovery of the animal following electric shock. Electrodes on the atloido-occipital membrane and in the nose. Current 600 milliamperes for two seconds.
A, B, C, D, and E as in previous charts. X, Y, S, and R as in previous charts. N — stimulation of the central end of the cut sciatic nerve.

to the membrane. The behaviour of the curve is much the same as in Chart 1, except that there is no evidence of the secondary (asphyxial) rise in blood pressure (phase 5). This rise is, in fact, rarely seen in this group. The cardiac pulsations gradually become very faint and cease to register on the tracing in about four minutes, although they can usually be heard with the stethoscope for about six minutes.

The effect of the application of artificial respiration on the blood pressure of animals which have received an apparently fatal shock is well shown in Charts 3 to 6. In the majority of these, it will be noted that the immediate response to the shock (*i.e.*, in phases 1, 2, and 3) is similar to that shown in Charts 1 and 2. The tracing in Chart 3 is fairly typical. In two minutes and twenty seconds, when the blood pressure had fallen to within a few millimeters of the base line, artificial respiration was applied. The blood pressure immediately commenced to rise and in less than one minute natural respirations set in, followed by a return of the blood pressure to or above its normal level. The other tracings vary only in the rate of response to this treatment; this would appear to depend partly on the severity of the shock and partly on the promptness with which artificial respiration is commenced. Chart 4 is particularly interesting, since it shows a series of immediate responses to the repeated application for short periods of artificial respiration, each period of recovery being followed by a fall in blood pressure, until after several such trials natural breathing set in and the pressure was sustained. It would appear that the primary effect of artificial respiration is to supply to the muscles of the heart properly oxygenated blood and thus provide for its improved action. An equally important effect is, of course, the concurrent supply of oxygenated blood to the centres of the brain, assisting materially in relieving the block to those centres.

Cause of Phenomena Observed

Experiments were now undertaken to determine, if possible, the exact cause of these phenomena. With this object in view, while the blood pressure tracings were being taken the heart was directly observed through a window in the chest wall. Rabbits, cats, and dogs were used in these observations with essentially similar results.

Circulatory System.—During the period of the passage of the electric current (phase 1), the heart was seen to be completely inhibited in the rabbit and the dog, while in the cat the inhibition was not so complete although the beats were not of sufficient force to register on the tracings. This inhibition of the heart is the result of stimulation of the vagus centres, as was demonstrated by the following experiments. A rabbit was prepared in the usual manner and the vagi were dissected and severed at the level of the cricoid cartilage. On the passage of the current, the heart was found to be inhibited to a much less degree than when the vagi are intact. Sufficient atropine was then injected intravenously to block effectively the vagus nerve endings in the heart (as tested by stimulation of the peripheral end of the vagus). In a few minutes after

the injection, the heart was in no wise affected by reapplication of current through the electrodes. This would show that when the vagi are intact the heart is inhibited through stimulation of the vagus centre. The fact that following section of the vagi some degree of inhibition is obtained is evidence that there are extravagal inhibitory fibers to the heart. When these are controlled by the administration of atropine no inhibition is obtained on the passage of the current.

The passage of the current also paralyzes the vagus center itself so that the heart cannot be inhibited reflexly for some time after its passage. In the tracings of Chart 5 it can be seen that, before any current was applied, stimulation of the central end of one vagus nerve caused a distinct (reflex) fall in blood pressure. After application of the current, natural breathing was absent and artificial respiration had to be applied. During this stage, stimulation of the vagus, as before, had no effect on the blood pressure, nor did any effect become evident until some time after normal breathing had returned and the conjunctival reflex could be elicited. This result is interpreted as showing that a complete block had been established at the vagus nerve center, as a result of the passage of the current.

It was usually observed that, in addition to a more or less complete inhibition of the heart during the passage of the current, the venous side of the circulation becomes greatly distended with blood, this condition resulting from the combined effects of the generalized tonic contraction of all the muscles in the body and stimulation of the vasoconstrictor centers in forcing the blood into the venous side of the circulation. The sudden cessation of this tonic spasm, when the current is broken, momentarily reduces the pressure on the arterial side so that the blood pressure falls (phase 2).

The rapid increase in blood pressure which immediately follows this momentary fall (phase 3) occurs because the blood which had accumulated in the venous side is being forced into the arterial side of the circulation, and while this is happening the heart beats are very powerful. That the whole arterial tree is affected is shown by an increase in kidney volume synchronous with the rise in blood pressure. As soon as the excess of load has been delivered, the heart beats become relatively normal in character but the rate is greatly increased. It may be interesting to note here that the increase in blood pressure is never so marked in the cat as it is in the rabbit and the dog. This is probably due to the fact that the cat's heart is not completely inhibited during the passage of the current. It may be noted, also, that this rapid increase in blood pressure is a probable cause of many of the capillary hemorrhages which microscopic examination reveals in the brain and the spinal cord.

The blood pressure remains at its high level for a few seconds and then falls more or less rapidly until the basal level is reached (phase 4). The fall in pressure which soon follows the rise (phase 4) is due, primarily, to a generalized vasodilatation resulting from inhibition of the vasoconstrictor nerve center similar to the inhibition

described in the respiratory center. The result of this can readily be demonstrated by kidney volume tracings and by direct observation of the vessels, which are usually found to be markedly dilated at this time. We consider this inhibition of the vascular tone to be of the greatest importance as a cause of death, since the blood thereby stagnates in the peripheral blood vessels. The systemic circulation becomes embarrassed because of the inadequate blood supply to the heart and the heart beats with rapidly decreasing force till in five or six minutes it stops entirely.

In an animal which has received a sublethal dose of current this paralysis of vasomotor tone is not complete, and frequently a secondary rise in blood pressure accompanies the onset of asphyxia (phase 5). In such cases voluntary respiratory efforts usually appear shortly after the recovery in blood pressure, although in some cases artificial respiration may have to be applied. The most probable explanation of this rise is that the vasoconstrictor and the respiratory centers have not been so profoundly affected but that they can be stimulated by the accumulation of carbon dioxide in the blood.

Nervous System.—In an endeavor to determine whether any constant pathologic lesion of the nervous system is associated with the passage of the electric current in the manner described, the brains of the majority of the animals were removed and sectioned in paraffin by D. J. Bowie. Since the phenomena produced by the current are apparently those of a more or less temporary nerve block, it was not expected that any typical leison would be found. It has been demonstrated that short periods of asphyxia alone produce definite changes in the structure of both sensory and motor nerve cells, those of the cerebellum and the cerebrum being the most sensitive. One must, therefore, take great care in the interpretation of similar changes before attributing them to the action of the electric current as such. For the present, we have concentrated on the occurrence of capillary hemorrhages in the brain and the spinal cord since many writers state that this is the most constant feature of death by electric shock.

It was at first thought that these hemorrhages might possibly be associated with failure of the cardiac and the respiratory centers of the medulla, but the study of a great many sections failed to produce sufficient evidence for assuming that there is any such association. While small hemorrhages were frequently found in the proximity of the dorsal motor nucleus of the vagus nerve, they were just as frequently found in other parts of the brain and the spinal cord. Hemorrhages were somewhat more frequently found at the root of the acoustic and the facial nerves. No definite relationship could be made out, however, between the severity of the shock and the presence of these hemorrhages in any part of the brains. Animals which had received a sublethal dose of current sometimes showed on subsequent examination as severe hemorrhages as a definitely fatal case, while in some of the fatal cases no hemorrhages could be found. On the other hand, somewhat similar hemorrhages were found in the brains

of animals which had not been subjected to an electric current. When hemorrhages do occur in animals subjected to an electric current, they are, therefore, as stated above, most probably due to the sudden great increase in blood pressure which follows the passage of the electric current through the body, and not to the local effect of the current. Their presence is probably not an important factor in death from electricity.

Summary

The initial effect of the passage of the alternating current through the brain is intense stimulation of all the centers in its path. There is a generalized muscular contraction which, together with a pronounced vasoconstriction, results in a great accumulation of blood in the venous side of the circulation. The stimulation of the vagus center causes inhibition of the heart, an effect which, to a large extent, can be obviated by section of both vagi. That there is not total absence of inhibition of the heart with this procedure is evidence that there are extravagal inhibitory fibers, and when these are controlled with atropine there is no inhibition of the heart on the passage of the current.

When the current is broken, this period of stimulation is followed by a period of profound inhibition or paralysis of all these centers. The animal becomes limp and unconscious; respiratory movements are absent; the eye reflex cannot be elicited; the blood pressure rises to almost twice the normal and then falls with the dilatation of the blood vessels even although the heart beats at an increased rate; there is no reflex response to sensory stimulation (stimulation of the central end of the cut sciatic nerve, Chart 6), and severe stimulation of the central end of the cut vagus has no reflex effect on the heart (Chart 5).

That this paralysis may be only temporary is shown in our experiments by the fact that artificial respiration brought about recovery in all cases in which no gross damage to the brain or the spinal cord had been done by the heat generated at the point of application of the electrodes. That gradual recovery may follow the period of paralysis is clearly shown in Charts 3 to 6. With the return of consciousness all the reflexes return, and in the majority of instances there is an interval of only a few seconds between the initial breath and their return (Charts 5 and 6). The failure to recognize a constant definite pathological lesion in the brain or the spinal cord of an animal subjected to an electric shock is also evidence that the paralysis may be of only a temporary nature.

It seems, therefore, safe to conclude that it is the nerve centers themselves that are paralyzed by the passage of the current, so that impulses reaching them are completely blocked and the normal rhythmic discharge of the respiratory center ceases. This explains the failure of counter stimulation as an aid to resuscitation. It also explains the failure to obtain reflex vagal inhibition of the heart in the shocked animal. It is only after the application of artificial respiration with efficient aeration that the inhibition can be observed to pass off. Furthermore (as shown in Chart 4), it is exceedingly important that artifi-

cial respiration be commenced early and be maintained for a sufficient length of time.

Conclusions

1. The experiments herein described confirm the deductions of previous observers as to the cause of death in electric shock : namely, that it may be due to primary cardiac failure, to primary respiratory failure, or to a combination of both.

2. In laboratory animals, when the current traverses the body from the head to a hind limb, about 45 per cent. of the deaths are of purely cardiac origin. The remainder of the deaths occur because of failure of the respiratory movements.

3. In these, as in the group in which the current is passed directly through the brain, a condition of profound paralysis or block becomes established in the respiratory, vagus, and vasomotor centers.

4. That the block involves these centers is shown by experiments which demonstrate clearly the absence in electrocuted animals of reflex effects normally functioning through them. Since the nerve centers become insensitive to extraneous influences, counter stimulation is not an aid to recovery.

5. No definite histologic changes can be made out in the brain to account for the symptoms. The capillary hemorrhages which occur do not appear to be significant.

6. The foregoing experiments also show definitely that when the electric current does not cause charring of nerve structures the paralysis or block is recovered from and the reflexes return, provided efficient artificial respiration is applied.

7. It is of the greatest importance that artificial respiration be applied early and be maintained for a sufficient length of time. Owing to the nature of the block in the nerve centers the ordinary tests for death should not be accepted and "nothing less than cooling of the body or the onset of rigor mortis should be considered to be evidence of death.

The thanks of the writer are due to Prof. J. J. R. Macleod for his stimulating interest and helpful criticism ; to Mr. Wills Maclachlan, Consulting Engineer, for his kindly advice and assistance throughout the progress of the work ; to Dr. R. E. Gaby, Surgeon, for his assistance in the earlier stages of the experimental work and for notes from his clinical cases ; to Mr. F. L. Harrison, Electrical Assistant, High Tension Laboratory, Hydro-Electric Power Commission of Ontario, for his assistance in the handling of the electrical facilities and for his co-operation in surmounting the numerous technical difficulties of the research ; to D. J. Bowie, B.Sc., M.A., for the histologic sections ; and to the numerous members of the staff of the Hydro-Electric Power Commission who were of great assistance in many ways.

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Eugenia Hydro-Electric Association

THE sixth annual meeting of the Eugenia Hydro Electric Association was held this year on the 8th of June at Chesley. This municipality, although not the first to utilize "Hydro Service" in the district, is deserving of distinction, from the fact that its local system is a model of efficiency and successful operation, and affords one of the best illustrations in the Province of how a local utility should be operated. It is also the home of Mr. M. A. Holliday, an official of the Association, and who has perhaps done more to promote the good interests of "Hydro" in that section of the Province than any other individual in the district.

The objects of the Association as set out in the Constitution are as follows :

(a) To take united action on all Public Utility matters in regard to the Eugenia Hydro System.

(b) To work in conjunction with the Hydro-Electric Power Commission of Ontario in promoting development of Public Utilities in this district and the Province.

(c) To suggest such legislation as may be deemed of advantage to the municipalities on the Eugenia Hydro-Electric System and to take united action thereon.

(d) To prevent by all lawful and expedient methods any encroachment on the rights of the municipalities of the Eugenia System.

(e) To confer with the officials of the Hydro-Electric Power Commission of Ontario regarding any large expenditure on the Eugenia System before same is undertaken.

The Association was formed at its first meeting in Durham in 1922, and meetings have been held annually since that date at Owen Sound, Wingham and Hanover.

The programme this year was the most comprehensive of any meeting yet held, and consisted of :

The President's address—by Dr. Fowler, of Teeswater, who gave a resume of the progress of "Hydro" throughout the Province, with special reference to the Eugenia district.

An address by Mr. T. C. James, District Engineer of the Hydro-Electric Power Commission, on the financial standing of the Georgian Bay System, and an explanation of the "Rate Stabilization Fund" and the "Equity" of the municipalities

in the Georgian Bay System, of which the Eugenia district is a part.

An address by Mr. J. W. Purcell, Assistant Engineer of the Hydro-Electric Power Commission, and the expert on rural distribution, on "The Uses of Electricity on the Farm." As the Eugenia district contains some of the best agricultural areas in the Province, and as the farmers in this section have not taken advantage of this valuable asset, Mr. Purcell's remarks were most appropriate, and it is to be hoped that the local Commissions and Systems will follow up the suggestions given, in order that the rural communities adjacent to them may also become users and obtain all of the benefits possible from the service available.

An address by Mr. T. J. Hannigan, of Guelph, on the "Pension and Insurance Scheme for Local Utilities". Mr. Hannigan's remarks were most interesting and the subject very ably handled.

An address on "Accident Prevention", by Mr. Wills MacLachlan, which was presented in his usual clear and interesting manner. Mr. MacLachlan also gave a demonstration of resuscitation from electric shock for the benefit of the delegates present.

The officers for the coming year elected at this meeting are as follows :

President—
Dr. G. S. Fowler, Teeswater.

1st Vice-President—
Mr. C. J. Halliday, Chesley.

2nd Vice-President—
Mr. J. Lucas, Markdale.

Sec.-Treasurer—
Mr. C. C. Elvidge, Durham.

Executive Committee—
Mr. Alex. Londry, Meaford.
Mr. J. Richardson, Grand Valley.
Mr. J. R. McLinden, Owen Sound.
Mr. W. H. Gurney, Wingham.
Dr. Beacom, Mount Forest.
Mr. S. F. Ballachy, Paisley.
Mr. Robt. Mullen, Lucknow.

The meeting for next year will be held at Meaford, and it is to be hoped that the other municipalities of the Georgian Bay System, from the Severn, Wasdells, and Muskoka districts will send delegates in order that the Association may be representative of the entire Georgian Bay System.

Hydro News Items

Central Ontario System

The new Hinde & Dauch factory at Trenton started operation last month. Only a small amount of power will be used at present until the plant is in running order.

* * * *

A considerable increase in load is expected at Oshawa, within the next few months. The General Motors Company is making extensive additions to its plant and the Oshawa street railway is installing rectifiers of considerably greater capacity than the existing motor generator sets. The rectifiers will eventually replace the motor generator sets, as they have been found more efficient on light loads.

* * * *

Rural extensions are now under way in Pickering, Cobourg, Port Hope, Peterborough, Newcastle and Oshawa rural power districts.

* * * *

Georgian Bay System

Electric power for the purpose of operating pumps in connection with the Bradford Marsh Drainage Scheme has now been made available. Additional transformer capacity has been installed in the Bradford sub-station, and changes have been made in the Bradford distribution system to provide a 4,000 volt feeder for delivering power to the pumping plant. It is expected that the pumps will be placed in operation about the middle of June.

* * * *

The Public Utilities Commission of Midland has completed a contract with the Midland-Simcoe Elevator Co. for 1,500 h.p. for the purpose of operating a 2,500,000 bushel elevator, which will have a capacity of 5,000,000 bushels when ultimately completed. The company will be served at 22,000 volts, and expects to be in a position to begin operations in September or October of this year.

* * * *

Thirty kw. voltage regulators with 13 per cent buck and boost have been installed on the Port Perry and Uxbridge distribution systems for the purpose of improving the voltage regulation in these two municipalities, and the results to date have proven very satisfactory. The engineering and construction work was performed by the Hydro-Electric Power Commission and the equipment will be operated by the local utilities.

* * * *

An extension has been constructed to the distribution system in the Georgina Rural Power District to serve a number of summer cottages at Port Bolster on the south side of Lake Simcoe in the vicinity of Beaverton. This extension will take care of approximately twelve customers.

A rural line is under construction in the Orangeville rural power district which will serve the southern portion of Amaranth Township, as well as the northern portion of Garafraxa Township. Service will be given immediately to a total of 19 consumers, all of which are farm contracts, and it is expected that this district will be in operation about August 1st.

* * * *

Niagara System

A rotary converter station having a capacity of 500 kw. was recently put into operation by the Commission in Ford City. This station is necessary on account of the increase in traffic in the Border Cities.

* * * *

An outdoor type substation consisting of 3 75 kv-a single-phase transformers, 13200/4000 volts, will very shortly be installed at Thamesford. This station will take care of the power supply to the Police Village of Thamesford and the Rural Power Districts in that vicinity.

* * * *

Arrangements are being made by the Engineering Department of the Commission for the installation of 3 500 kv-a outdoor type 26400/4000 volt transformers at Simcoe for the Simcoe Hydro-Electric System, the loads in the Municipality having rapidly outgrown the present station capacity.

* * * *

St. Lawrence System

The village of Athens has applied to the Commission for a supply of power. This village, together with the intervening rural district which includes a number of hamlets, could be served by an 8,000-volt line from Brockville.

Canadians are Setting New Records

Between 1901 and 1925, Canada changed from an agricultural country into one in which manufacturing is equally important. Manufacturing production has grown from 214 to 1,311 millions of dollars. Forest production practically doubled. Mineral production increased from 66 to 228 million dollars. Coal output grew from 4 to 13 million tons and mileage of Canadian railways from 18,149 to 52,692. The wheat yield in 1926 exceeded $406,000,000, and the field crops totalled $1,131,241,000.

During this period, Canada's foreign trade rose from 196 to 1,878 million dollars a year, and per capita exports from $36 to $115. Never before in the history of the world, have such increases been recorded in a nation's trading in a similar period.

Because of its vast size, Canada needs a great influx of immigrants, but whilst recognizing to the full the desirability of increased immigration, it should not be forgotten Canada is increasing her population at a much greater rate than countries which compete with Canada for new immigrants.

Canada's remarkable growth in the period under review is due to increasing efficiency of its people, and its manufacturing methods. In the Dominion, over 47 per cent of the total population are engaged in gainful occupations; in the United States

the proportion is 31 per cent. The efficiency of production index figure in Canada has risen from 97 per cent in 1920 to 128 per cent in 1924, according to the Canadain Business Research Bureau, which has compiled the figures on which our comparisons are based.

International trade experts place growing reliance on the length of the business cycle as an indication of stable business. In Canada the average business cycle is 5.1 years; in the United States it is 4 years.

Canadians have every reason to be proud of their record as a nation of home owners. Over 70 per cent of the total homes in Canada are owned by their occupants, a proportion which is unapproached by any other nation. Roger Babson has publicly stated that "nowhere on the American continent are living conditions better than in Canada." Comparison of family budgets, cost of living, etc., indicate that Canadians are setting up new records.—*Simonds Guide for Millmen.*

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in May, 1927.

Appliances

CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ont.

"Westinghouse." Industrial air heater, stationary type, wall mounting. Style No. H. 21330.

* * * *

EQUATOR ELECTRIC LIMITED, 146 York Street, Hamilton, Ont.

"Equator." Air heater, reflector type. Cat. Nos. A.17 and A.7.

Table Stoves. Cat. Nos. A1.4, B.14, A.15, B.15, A.18, B.18.

Toaster. Cat. No. A.8.

Mantel Grate for wall mounting. Cat. No. C.26.

* * * *

COLDWELL LAWN MOWER COMPANY, Newbrugh, New York.

"Coldwell." Electrically-operated Lawn Mower.

THE FILM AND SLIDE CORP. OF CANADA, LTD (Submittor), 156 King St. W., Toronto 2, Ont.

THE HALLDORSON COMPANY (Mfr.) Chicago, Ill.

Photo Studio Lamp.

* * * *

OSWALD GAREAU, 6 De Beau Jeu, Hull, Que.

Electrical Equipment for Oil-burning Furnaces.

* * * *

GRANT AND THORPE, Peterborough, Ont.

Portable Lamp Display Rack. "Grant & Thorpe."

* * * *

KENNEDY & KENNEDY (Submittor) 1442 Yonge St., Toronto, Ont.

THE FRANCE MFG. Co. (Mfr), 10321-35 Berea Road, Cleveland, O.

"France" Type AH Heavy Duty, stationary battery charger.

REED & CAMERON, 188 Adelaide St. W., Toronto, Ont.

9-in. Square Table Stone.

* * * *

LA SALLE LEAD PRODUCTS, LTD., 630 Wyandotte St. E., Windsor, Ont.

Radio "B" Battery Eliminator. "LaSalle Bear-Cat."

* * * *

MARCELWAVER CO. OF CANADA, 110 Dundas Street, London, Ont.

Electric Marcel Waver.

* * * *

THE NORTHERN ELECTRIC COMPANY, LIMITED (Submittor), 131 Simcoe St., Toronto.

ELECTRO-MAGNETIC TOOL COMPANY (Mfr.), Cicero, Ill.

"Speedway" portable electrically-driven hammer and saw.

* * * *

SAVAGE ARMS CORPORATION, Utica, N.Y.

Savage All-Electric, motor-driven, portable ironing machine.

* * * *

*BECKWITH MFG. CO., 111 Summer Street, Boston, Mass.

Electro-vapor box toe heaters. Types 10AA,20, 12AA,12D.

* * * *

*EASTMAN KODAK CO. (Mfr.) Rochester, N.Y.

CANADIAN KODAK COMPANY (Submittor), Toronto.

Photographic Appliances (as listed on Underwriters' Laboratories card dated March 26, 1926).

* * * *

*FANSTEEL PRODUCTS CO., INC., North Chicago, Ill.

Radio "B" current supply unit. Designed to replace "B" batteries of radio receiving sets. Models K, KL, KM, BW, BWM, BWR, X, XL, XM, Y, YL, YM, KX, KXL, and KXM.

Battery Charger. Models J, JL, JM, and JR, K, KL, KM.

* * * *

*SANGAMO ELECTRIC CO. (Mfr.), Springfield, Ill.

SANGAMOL EECTRIC COMPANY OF CANADA, LIMITED (Submittor), 183 George St., Toronto.

Electrically-wound clock.

* * * *

*SCENE-IN-ACTION CORPORATION, (Mfr.) 1601 S. Michigan Ave., Chicago, Ill.

SCENE-IN-ACTION COMPANY (Submittor), 24 Adelaide St. E., Toronto.

Electrically-illuminated portable fixture for display use.

* * * *

*SERVEL CORPORATION, 51 E. 42nd St., New York, N.Y.

"Servel" refrigerating machine—household.

* * * *

*STERLING SIREN FIRE ALARM CO., THE, INC. (Mfr.), Rochester, N.Y.

AMERICAN LAFRANCE FIRE ENGINE CO. OF CANADA, LIMITED (Submittor) 195 Weston Road, Toronto 9, Ont.

Siren horns, indoor or outdoor use. Type M, Type F.

* * * *

Fittings

MAJESTIC ELECTRIC MFG. CO., 806 North 12th St., St. Louis, Mo.

"Memco." Porcelain receptacle, cleat type. Cat. No. 50715.

* * * *

SMITH AND STONE, LTD., Georgetown, Ont.

Pressed copper soldering lugs. "SS" Ground Clamp. "SS."

*METEOR ELECTRIC CORPORATION, 499 E. 70th St., New York, N.Y.

Medium Base Sockets, Keyless. Cat. Nos. 103-0 to 103-4 inc.; 203-0C to 203-4C inclusive.

* * * *

Switches

SQUARE D COMPANY, CANADA, LIMITED, Walkerville, Ont.

"Square D." Convertible power panel boards.

* * * *

TAYLOR ELECTRIC MFG. CO., LTD., 526 Adelaide St., London, Ont.

Rural Service Entrance Switch. Cat. No. R-2536 S.N.

* * * *

Miscellaneous

L. S. BRACH OF CANADA, LTD., 130 Richmond St. West, Toronto 2, Ont.

Lightning Arresters. Storm King and Storm Guard. "L. S. Brach."

*PHILLIPS ELECTRICAL WORKS, E. F., Ltd., 5795 De Gaspe St., Montreal, Que.

Armored Cable.

Marking: Green and yellow threads woven in overall braid of conductors.

* * * *

*TRIANGLE CONDUIT CO., INC. (Mfr.) Dry Harbor Rd., and Cooper Ave., Brooklyn, N.Y.

CANADIAN TRIANGLE CONDUIT CO. LIMITED (Submittor) 21 Prescott Ave., Toronto.

"Triex" or "Triangle Non-metallic Sheathed Cable."

Marking: One purple thread laid parallel with the wire under the helical wrap of each conductor.

* * * *

* These devices are under the Underwriters' Laboratories re-examination or label service.

Re Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.—*Editor*

THE BULLETIN

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Opportunities and Duties of Electric Utilities

By A. K. Baylor, General Electric Co., New York

(Address before Association of Municipal Electrical Utilities at Niagara Falls, Ont., June 24, 1927.)

MY experience is based largely upon contact with private company operations in the United States, and I can claim little intimate knowledge of municipal operation in Canada. Still, the phase of the business that I want to discuss finds us, I am sure, on common ground, and I believe, from what I know of your operations, that the conditions under which I have gained my experience are fundamentally parallel with your own.

Under the text, "Opportunities and Duties of Electrical Utilities," I will deal particularly with the development of domestic service. Such service is a concrete thing, wherever it may be and under whatever auspices it is made available ; and home everywhere is the foundation of a community and the essence of civilization.

Having been actively connected with the electrical industry for over 36 years, I find it interesting to turn back to the early days and compare them with the present, especially with reference to domestic use of electricity.

At first there was nothing but lighting and not much of that. In fact it was soon demonstrated that a great many of those who first accepted electric lighting in substitution for gas, or other means of illumination, were unprofitable customers and cost more to serve than they paid for current. The electric light and power industry never got on its feet

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at all until the general purpose motor came into use and profitable power loads counterbalanced unprofitable domestic lighting business.

Later came the development of alternating current distribution, the transformer and induction motor, increasing the range and economy for both power and domestic uses ; but, after this, fifteen years elapsed before domestic appliances reached a stage of practical development and acceptance that turned the attention of the light and power companies to the far-reaching possibilities of electric service in the home.

From about 1910 up to the outbreak of the Great War notable progress was made in the introduction of domestic appliances and many of the operating companies established Commercial and Merchandising Departments. During the war period, this development was checked for two reasons ; first, demands of war emergencies overtaxed the capacity of the power companies—power in many communities having to be rationed, and no effort could be made, for the time being, to stimulate new domestic demand.

Another check was the organized opposition of jobbers and dealers who resented the entrance of the power and light companies into the merchandising field ; claiming that such business was outside the scope of public utilities and that their competition menaced the very existence of the retail distributors of electrical merchandise. So matters rested until the memorable depression of 1920 and 1921, when the curve of revenue of our electric utilities for the first time turned downward, and these utilities found the financing of necessary extensions very difficult, even at onerous rates.

Then followed a general renaissance of merchandising activity in the ranks of the electric light and power companies, because possibilities of domestic load development had been demonstrated, and it was obvious that such load offered the most immediate opportunity for building up revenues with a minimum investment for new generating and distribution facilities.

During the last two or three years, one of the leading activities of the National Electric Light Association, through its Commercial Section, has been the strengthening of commercial and merchandising departments of power companies and expansion of domestic service ; and there is every reason why these companies should be so engaged.

First, it is obvious that the source of electric power is the heart of every

electrical community and that every circuit, service accessory or device for the utilization of power becomes a part of the physical body of the community network, and is utterly useless until energized and kept alive by the vital current from the generating reservoir. The custodian of power, whether company or municipal body, which has prime responsibility for electrifying a community, and sole responsibility for serving it when electrification is effected, is vitally concerned with whatever is connected to its lines and made a part of its physical body. Whatever happens in the way of trouble or failure to function at the customer's end of the line jeopardizes the goodwill of those responsible for power supply ; to whom the public looks first and immediately for relief, no matter who may have sold or installed the thing itself.

It is undoubtedly true that no particular application of electricity will reach its full development in any community unless actively fostered by the power supply authorities. They are involved necessarily in any representation made to the public as to apparatus or appliances and their use ; and, because of the heavy burden of investment, they are under a compelling necessity to build up loads and cannot depend solely upon other agencies, lacking their preeminent responsibility, strength, prestige and incentive. They alone are equipped to study load building with reference to demand curves and so improve load factor, and, consequently, investment efficiency.

They are in a particularly favorable position to act as leaders ; being the recognized authority on matters electrical and in physical connection and continuous relation with the public served. They may maintain house to house contact without sole recourse to the doorbell attack which has become so general and often objectionable. They are also best qualified to apply to the upbuilding of this business a steadying flywheel effect and so wean it away from too much dependence on frequent and debilitating hypodermic injections in the form of so-called "campaigns."

For these reasons it appears that the power authorities are discharging a duty toward capital invested and the public served in engaging actively in merchandising. Moreover, their interest extends beyond merchandising profit into the broader field of customer goodwill. If merchandise profit were the main consideration municipal power departments or power companies might logically become general providers of any commodities in popular demand ; boots and shoes, for instance ; and even though confining sales to electrical merchandising they might be accused, with some justice, of exceeding the limits of their proper functions.

In the United States many power companies have been so criticized ; especially where the merchandising operation, as often happens, shows a deficit. It is claimed that such operations, in addition to being damaging to other branches of the trade, are a burden upon the rates. These complaints, however, ignore the considerations that have been mentioned as well as the fact that power authorities must bear a substantial burden in pioneering new

applications. This is a necessary promotional expense ; as the most liberal effort of manufacturers does not entirely cover the ground.

There seems to be as much logic in entering such expenditures as a loss on account of merchandising as in entering as a debit to operation the cost of new generating and accessory equipment to carry the prospective resultant load. The power source is, in effect, a manufacturer and vendor, and like any other manufacturer must depend—if it is to have close relations with its clientele—upon an efficient and active sales department ; and the more so because every customer, once connected becomes perpetually dependent and tributary. It appears then that not only the propriety but absolute necessity of intensive and comprehensive commercial activity on the part of the power supply agencies is established beyond question ; and the allocation of overhead and operating expenses of sales departments should take into account all their contributing functions.

There is, however, another side to the picture which involves the interests of other branches of the industry—including the manufacturer, jobber, dealer and contractor—as well as the interest of the power supply authorities reflected from these other branches. Obviously the ultimate objective—public service—can only be attained by conjunction of all branches of the industry. If any one of them is unduly weakened, the public suffers. Certainly, therefore, the sales department of the power supply organization should operate on such a basis as to prices and terms, on standardized appliances, as not to involve unfair competition with the local trade or other necessary elements of the industry.

Let us consider now some of these other factors in the situation.

What is the place and function of the jobber ? His indispensability as a distributor of contractors' materials is universally recognized. In the rapidly expanding field of merchandising, however, and particularly with reference to household appliances—opinions differ widely as to the jobber's place.

Some power officials feel that they are entitled on all merchandise to the direct benefit of established jobber discounts and even lower prices, because of quantity purchased.

Jobbers, on the other hand, claim that it is unfair to expect them to maintain organizations to distribute low margin necessities and deny them participation in the field of staple and standardized appliances. It is idle, I think, to argue from the standpoint of unfairness. The question is "What inherent economic function is actually performed by the jobber or any other branch of the trade fraternity ?" Volume, certainly is a vital factor in cost of production—if bulked so that manufacturing operations are affected—and purchasers in every class are entitled to consideration on this score. But production is only the beginning of the process of serving the public ; which involves also facilities of distribution.

Out of every dollar paid by the ultimate consumer for electrical merchandise, between 50 and 60 cents, on the average, goes to the manufacturer for financing works, plant, invention and development ; to provide work-

ing capital for payrolls and inventories of raw material, work in progress and finished products ; for advertising, sales expense, interest and dividends on invested capital. The other 40 to 50 cents is absorbed in the cost of delivery to the user ; and this carries no undue profit to any element in the chain of distribution, either wholesale or retail.

It is an accepted principle that the establishment of competitive electrical power plants and lines in any community, with duplication of investment and operating expense, results in a disadvantage to the public, both in cost and quality of service. Such disadvantage arises also from unnecessary duplication of distribution facilities, or any other part of the trade structure.

Would those responsible for power supply, taking all lines of material and every other factor into consideration, advocate the complete elimination of the electrical jobber ? In reply it is safe to answer "Certainly not !" If this is the correct answer, and it appears to be so, then not only the jobber's right to broad consideration but the necessity of such consideration, in the common interest, is established.

If any power distributing authority will accurately segregate the cost of warehousing and handling, the liability involved in promptly meeting customer demands and the menace of depreciation and obsolescence, it will find that it cannot, in the long run, serve itself as economically as an institution organized and equipped solely to perform those functions. With rare exceptions the power authorities need the jobber's service in order to meet diversified demand, make prompt deliveries and *keep down inventories.* Inventories—the *bête noire* of the merchandiser, the wreckers of balance sheets and the delight of the manufacturer of red ink—are responsible for much grief; and the merchandising departments of power supply organizations have not escaped their full share. Next in line is the dealer who is an important and necessary factor in the chain of service. In most communities, especially the larger ones, the dealer's position is a difficult one primarily on account of the multiplication of such outlets beyond the point that the available market will profitably support. Many enter the business without careful analysis of the market and their numbers have been increased by zeal on the part of distributing jobbers, who, finding existing dealers committed to competing products—have created new outlets. To further aggravate the congestion many contractors have entered the merchandising field.

Another factor of difficulty for the dealer is the growing volume of electrical merchandising by the non-electrical trade ; such as department and hardware stores and furniture dealers. Such outlets represent an increasing percentage of distribution and in the case of the department store, particularly, the reason is obvious. Household appliances are largely sold to women and their daily rendezvous is the department-store, where they go as aggressive buyers instead of waiting to be solicited at the call of the doorbell.

A serious problem of retail distribution is the question of exclusive

representation ; sometimes imposed upon, but more often demanded by, the dealer. It is to be hoped that the time may come when the chief factor in retail exclusiveness will be outstanding excellence of a certain line of quality products. Why should we not look forward to such a practice in the field of electrical merchandise ? We do not have to seek out certain grocery, drug or department stores to find pre-eminently popular and nationally advertised brands ; the successful merchant in these lines must carry them.

Sometimes the power supply authorities have taken exclusive agencies in the territories they serve, cutting out other local dealers and the territorial jobber. This appears a short-sighted policy. If the leading authority in a community advocates a certain appliance and encourages others to do the same, then instead of trying to break down that leader's recommendations, other dealers will support them. A greater volume of sales for all parties is likely to result, with an advantage to the power authorities because of a lesser variety of types in use that must be serviced and cared for. The retailer is the immediate contact with the public and should be a conscientious adviser and guide ; and in self-interest, the power authority's competition with local dealers should be sympathetic.

On the other hand, all dealers, including non-electrical outlets, should realize that their own customer goodwill is, in the last analysis, in the hands of those who are responsible for electric service, and that low grade sub-standard products cannot be introduced into the power line network with impunity.

It has been demonstrated on the one hand that vendors of power benefit from the efforts of all dealers in high-grade material and, on the other hand, that the business of such dealers is best where the power authorities engage in merchandising and bring to bear upon this activity all their exceptional facilities.

The correction for undue multiplication of retail dealers must be a weeding out process until a balance is established between the local market and economic capacity to serve. This balance will be established sooner if power authorities encourage and support those who maintain high standards of products distributed and of trade practices—setting an example in their own operations.

Another important link in the chain of electric service is the contractor. While often bracketed together, the contractor and dealer represent two distinct functions. Generally in the industry, as now constituted, the contractor's place is established ; and he is entitled to support and encouragement, so long as he appreciates that, more than any other branch of the business, his is a direct function of power supply. He takes, so to speak, the hosepipe from the reservoir of power to the point of its application and must see to it that the work is safe and sound ; that circuit capacities and outlets are up to present day requirements and that unnecessary expense does not retard extension of electrical service.

Wiring is as important and necessary in modern house equipment as a heating system or water supply ;

but too often wiring has been purchased by an ignorant customer on a price basis. The installations have then been skimped and the arteries and veins, without which power cannot be marketed, have been restricted, clogged and throttled.

While much progress has been made in establishing standards for public guidance that balance safety and adequacy against costly elaboration, the avoidance of either extreme is largely in the contractor's hands. If he appreciates this responsibility and operates accordingly, he will prosper ; if not, he will dig his own grave.

Finally, let us consider the manufacturer who plays an important part in the electrical scheme of things. He is entitled to the principal credit for the rapidly broadening scope of the industry. Research, engineering initiative and facilities of production have carried the art by leaps and bounds from crude beginnings to its present position of universal public servant.

The problems of high voltage and widened range of transmission, greater unit capacities of generation and distribution and increased efficiencies have been solved by the manufacturer.

He has also devised and produced the means of practical utilization of electric service for almost every conceivable industrial and domestic purpose. Those who have done so much in the interest of all are entitled to their share of sympathetic support, but after all the power source—as distributor of the vital fluid that *is* electric service—remains the nucleus of the industry. Its capacity and range of delivery are the measure of the manufacturers' market and the manufacturers' ability to help build up loads through sale of electric commodities is limited by the policies of the power authority in every community.

In many cases, however, responsible manufacturers who have borne the expense of research and contributed heavily to promoting the industry have been at a disadvantage through competition with cheaper products—not merely less expensive but of inferior quality—free from these heavy elements of cost.

Engineering advancement is not spontaneous, and nature yields her secrets only to costly and persistent research.

Readiness to serve and the act of serving involve capital investment and operating charges as much with the manufacturer as with the vendors of electric service. All these things are involved in the cost of the finished product and in economics, quality and service are factors of price.

When the day comes that the price of a manufactured product is the sole governing consideration, research and other stimulating industry contributions must be curtailed or eliminated in justice to capital invested. When that day comes the advancing standards of the art will halt and turn backward.

Because of the nature of electric service, all elements in this industry, more than in any other, are interdependent. None is sufficient unto itself—not even the great heart of it—the source of power.

In recent years an important element in the sale of electrical appliances, as well as wiring, has been extension of the practice of instalment or "time-payment" selling. This has proved a helpful influence in developing domestic appliance business, and under proper credit control it is no doubt a sound practice. It appears reasonable that the individual is entitled to his reasonable credit *now* for all necessities, and even for moderate luxuries. Unless the industries had been able to borrow money for the extension of production and service, industrial progress would have been much restricted. But the laws of credit, deeply rooted, are much older than the electrical industry, and should not be disregarded.

The leading companies engaged in financing instalment sales are now making concerted effort to emphasize the importance of a substantial "first," or "down" payment that represents a real investment by the purchaser ; and also limiting the period over which remaining instalments are spread. To turn over to a customer a valuable article with a trifling "down" payment is not a sale at all, but a consignment ; and a competitor may easily absorb this payment by a moderate cut in price, with the result that the original vendor must repossess a second-hand article.

Moreover, if periods of payment are too long extended, the purchaser may be coaxed into commitments beyond his reasonable means. Unless the tendency to sell on a negligible first investment, coupled with long-deferred payments, is checked, the instalment practice expanded in times of prosperity may become an economic menace in times of depression.

Many power companies in the United States have given these exceptional terms because they have ample funds at moderate rates, and because their chief objective after all is to get the load. When this is done, such a power company, although it may maintain market prices on a parity with other dealers, is in effect cutting the price. In trade, prices and terms are inseparable.

There are two reasons why the power authorities should not follow this course. One is somewhat ethical while the other is distinctly practical. Ethically, the power authorities, as important trade factors in a community, should not establish terms that have been proved unsound for business in general. Otherwise, the whole community credit system is undermined.

The more practical objection is that if the leading power authority grant terms that other dealers cannot meet, such dealers must retire from competition or sell cheaper goods. Then these inferior products will find their way onto the lines to the annoyance of the customer and embarrassment of the power authorities.

The prevailing high standard in lamps has been established by the manufacturers through patent control, but appliances generally are subject to no such control ; and products unfit and often unsafe for domestic use are widely distributed. The only effective cure for this condition lies, apparently, in the policies of the power authorities.

It would appear that municipal

bodies, in a fiduciary capacity towards all the public, should guard trade practices even more strictly than private power companies.

Electric service, next to the very air and food supply, has become the greatest public necessity ; so variously is it involved in every phase of modern life.

Our air supply costs us nothing, but if compelled to live in a vitiated atmosphere, we would pay anything within our means for pure air as a matter of course.

We hear much of rates and rate comparisons which in the United States have frequently served as political footballs for those who place personal popularity before a critical study of broad public welfare.

Low rates are desirable for all good things, provided they are self-nourishing—which is more than self-supporting. Below the self-nourishing point the public suffers rather than benefits. Even the immediate beneficiaries of any unprofitable service delude themselves ; for, in the long run, invincible laws re-distribute economic burdens. In the end the mass of the public pays all costs and absorbs all losses.

The individual citizen is concerned with minimizing his total expenditures and not merely with one item of the budget.

More attention is being given just now than ever before in the United States to the question of analysis of cost of service in each class and the establishment of rates on the basis of such analysis.

The greatest public interest is in low domestic rates and much pressure is exerted to effect reductions in that class in spite of the fact that the average load factor for lighting and small appliances is not much over 15 per cent.—85 cents of the dollar dedicated to domestic service being unproductive.

Under given conditions as of to-day, for instance, it is practicable to fix rates below actual cost in one class, and let another class carry the burden—the average of all classes yielding a return necessary to support the enterprise. If that other class is the manufacturer, cost of power is passed on to the public at a profit in the price of manufactured products ; and all is well, so long as growth of demand in all classes maintains the balance that exists to-day.

If, however, there is unbalanced growth—the unprofitable increasing faster than the profitable classes—the stability of the general service is threatened and upward revisions of rates may become necessary. If, on the other hand, rates are classified in accordance with cost analysis and the inducement of lower rates offered for increased demand and improved load factor in every class ; growth in every class will gradually be reduced, as demand and load factors improve ; and the service as a while will be on a soundly economic perpetual basis to the greatest ultimate public benefit.

But the spread between the high and low average charges for electric service are entirely negligible as compared with the value of such service even at the higher levels.

Should we double the average rates everywhere there would no doubt be much well justified public outcry and a check on development, but little reduction in the use of an established service that is vital—and worth, it

would seem as much as the average tobacco bill. In the United States more money is spent annually for tobacco than for electricity and more for cigarettes than for domestic service. But should we withdraw all electric service modern life would collapse in its tracks and grope blindly to find its feet again. The great obligation, therefore, of all power authorities is to see that their economic foundations are sound and will not fail under any superstructure of future demand that they may be called upon to support.

On our side of the border, it is estimated that the electrical markets are only ten per cent. developed—comparing present usage with saturation in every field where electricity has been successfully applied at all. I have no parallel figures for your territory, but granting a much higher percentage of development, there remains for electric power supply a vast opportunity.

In no direction does this opportunity loom larger than in the realms of domestic use and because of the supreme importance of home in the civic structure, the greatest duty lies also in that direction.

To this end all other branches of the industry must rally to the support of power supply ; and reciprocally, those responsible for that supply must in public interest and self-interest recognize, encourage and foster those other branches.

Upon such inter-linked relationship depend the opportunity and welfare of all and their joint capacity to perform the ultimate function of rendering a full and efficient public service.

Discussion

Mr. O. H. Scott, Belleville :

As I read the Electrical Journals, it seems to me that the Central Stations in the United States are more and more going into the electrical merchandising field. I would like to ask Mr. Baylor to confirm that. Also, the Superintendents and Commissioners here are not all sold on the idea that their utilities should be merchants. I take it from the talk which Mr. Baylor has given us today that he is trying to sell us the idea that Electric Utilities should be merchants. I would like to ask Mr. Baylor if that is not also the case.

Mr. Baylor :

I am not trying to sell you gentlemen anything. I am expressing the opinion that I have formed after thirty-six years' experience in this industry, and I spent fourteen years in England in municipal operations, which are in the majority there, and a great deal of my work was done with municipal bodies. I have reached certain conclusions and I am expressing them as facts, that Power Companies in the United States are, more and more, going into merchandising. The General Electric and the National body of the trade in that country, for several years, has been advocating that policy. To-day over 50 per cent. of the operating power companies in the country are in the trade, and are relatively merchandising, and the trend is steadily in that

direction. And I believe, for the reasons that I have attempted to outline, that by no other means will the public get the full force and benefit of electrical service unless the power companies put their strength and prestige and knowledge behind it, and encourage the local trade to co-ordinate its activities. Then we are going to have higher standards. You are going to cut out sub-standard stuff in certain lines. We are going to have competitive trade. We are going to have a number of dealers who can prosper. We are not going to have the woods full of the cut-raters—and there are lots of them with us—and the public is going to get the best service. That is my opinion and I am expressing it.

Mr. E. V. Buchanan, London :

Just to emphasize that last point a little more, I might tell you that, when the Prime Minister, Hon. Stanley Baldwin, introduced the Electricity Bill about a year or so ago in a speech at Birmingham, he brought out the point that it was not alone sufficient to develop power at large power stations at low cost, but that means must be taken whereby the public would be educated and whereby the public would be supplied with the proper appliances to utilize the energy so developed. I remember seeing that speech in the paper, and I cut it out and have used it often when put on the defensive with regard to our merchandising policy. And after all we have to remember, and I think I have said this before at these meetings, that the object of our activities is to provide the greatest good for the greatest number, and I do not think we should give too much consideration to the objections of a very few electrical contractors and dealers, most of whom were not in business when we started our merchandising activities. But I do think we should pursue a policy of live and let live, and if we can co-operate reasonably with these people we should do so.

Mr. Baylor :

I would like to add, just in confirmation of what the gentleman has said, surely that goes along with what I have already tried to put before you. In many communities where, after years of conflict between the jobbers and dealers on this practice of merchandising, and through political agitation, the Power Companies have withdrawn for the sake of peace, and they have found the development of their domestic loads absolutely creeping where it ought to be riding. They have come back into the business, and their service has gone up. They have again raised the question as to whether they should withdraw, and the dealers have come and said "No." Now, it takes years, you know, to rub into some heads the principle that two and two make four. But that is the idea. And I think we should all consider this matter, not as an argument *pro* and *con*, but as a fundamental. Let us find the fundamental, like the sun rises and everybody agrees it is right, and then we shall be right. With us, in our practice, this trend has been proven, I think.

Power Billing Based on Demand

By H. D. Rothwell, Municipal Dept., H.E.P.C., of Ontario.

(Read before the Association of Municipal Electrical Utilities at Niagara Falls, June 23rd, 1927)

THE first commercial use to any extent for electric power was street lighting which occurred approximately fifty years ago. Shortly after this Thomas A. Edison developed the incandescent lamp. This marked the introduction of electricity into the general lighting field. To-day we find that with the gradual development of the art the whole industrial and social system under which we live is interlocked with this great achievement in applied science. In the first instance electrical power was usually generated in small isolated plants, but these have gradually given away one by one to the more efficient and economical centralized and interconnected stations located on the many rivers of the country until to-day we find practically our whole industrial system dependent on these great installations and an ever-increasing demand for that mysterious power, "white coal".

With the creation of a new industry and especially one having a scientific nature, many problems will arise, and not the least of these is the determination of the basic principles upon which proper charges will be made for this new commodity.

During the arc lighting period and the early years of the incandescent lamp, it was customary to base rates at so much per month or per year, as the case may be, for the use of a lamp, depending on the type and size. This may be translated into so many units of lights for a certain specific purpose. The greater use of the incandescent lamp, however, soon revealed a condition of inequality with respect to the rates then charged, and the length of time the lights were used had to be considered.

Before the length of time a unit of electricity is used could be considered, a satisfactory meter was required in order to measure demand multiplied by time. Amongst the early devices of this nature was an ampere hour meter invented by Thomas A. Edison. This meter was one which relied upon the deposition of a certain amount of metal in a given time, and in consequence of its nature it was not adaptable to general commercial purposes. Shortly following this, Elihu Thompson invented the d.c. watt-hour meter, and a little later Schallenberger, the a.c. watt-hour meter. The use of the watt-hour meter has definitely made a distinct advance in the apportioning of the cost of electricity to the consumer, at the same time giving the producer an instrument which assisted him greatly in determining his costs of production. Since the requirements of lighting consumers bear a striking similarity one to another, a moderately equitable rate could be devised on the use of watt-

hour meters alone, but with a rapidly advancing science bringing about new uses for power in the home and the dawn of an entirely new era whereby industry was to absorb huge quantities of power in a multiplicity of ways, it became evident that the sale of power at so much per unit alone was no longer equitable from the standpoint of both the producer and the consumer.

As early as 1883, Dr. John Hopkinson, an eminent English engineer, first suggested that in making rates to the consumer the "maximum demand" was an item of first importance, and in his address before the Junior Engineering Society on the 4th of November, 1892, on the "Cost of Electric Supply", he laid the foundation of our present rate structure.

Based on the Hopkinson principles an attempt will be made to show what part the cost of distribution bears to the service charge and consumption charge in the supplying of electric service. The distributing costs of electric power from a modern system are usually divided into two groups, e.g., those which are fixed and those which are variable, and for a system supplied by Hydro-Electric power they may be summarized as shown below.

In this it is assumed that power is purchased from a Hydro-Electric source on a demand basis and, therefore, the question of distribution expenses only is considered and no attempt will be made to analyze the cost of generation. Distribution system operating labor is considered by most rate-makers to be very largely a fixed expense. This probably holds true for all save the larger systems, where requirements might be slightly re-adjusted to meet a depressed condition. By other rate-makers, however, labor costs are sometimes treated as variable because they might be eliminated if the plant was shut down, but a public utility will no doubt find it impossible to suspend its operations during slack seasons, and for that reason all operating labor might be considered as a fixed quantity. In a public utility, costs have long been classed

ITEMS	EXPENSES
Power purchased	Variable.
Substation operation	Fixed.
Substation maintenance	Fixed.
Distribution System operation	Fixed.
Meter maintenance	Fixed.
Consumers' premises expense	Fixed and Variable.
Street lighting operation	Fixed.
Promotion of business	Fixed and Variable.
Billing and collecting	Fixed.
General office salaries and expenses	Fixed.
Undistributed expenses	Fixed and Variable.
Interest	Fixed.
Sinking Fund	Fixed.
Depreciation	Fixed.

as fixed if they would continue although operations were stopped and variable if they would not.

An analysis of three large, three medium, and three small municipalities has been made with a view to determining a relationship between what is fixed and what is variable.

power, thus distributing the balance of fixed to variable expenses.

It will thus be clearly seen that the fixed expenses of distributing power is an item of great importance, and in the making of equitable rates for all classes of service a detailed study of every condition is necessary.

Since the relation of fixed to variable expenses in general hold to a reasonable degree with respect to each other in practically all municipalities, a further study has been made to determine those fixed and variable expenses for the various types of service rendered, and in doing this one typical municipality has been selected where complete and accurate information was available to make a detailed analysis of commercial power, lighting and street lighting uses.

Municipality.	Fixed Expenses	Variable Expenses	Total Expenses.
No. 1	$315,759.35	$592,637.49	$908,396.84
Per cent	34.7	65.3	
No. 2	322,784.34	545,023.15	867,986.49
Per cent	37.2	62.8	
No. 3	415,199.88	743,891.75	1,159,091.63
Per cent	35.8	64.2	
No. 4	97,649.81	141,407.68	239,057.49
Per cent	40.8	59.2	
No. 5	73,384.83	107,909.14	181,293.97
Per cent	40.4	59.6	
No. 6	77,744.11	165,172.72	242,916.83
Per cent	32.0	68.0	
No. 7	11,634.32	22,635.83	34,270.15
Per cent	34.0	66.0	
No. 8	28,312.78	70,237.99	98,550.77
Per cent	28.6	71.4	
No. 9	13,627.78	37,339.10	50,967.48
Per cent	26.8	73.2	

From the foregoing compilation it will be noted that for the larger municipalities, where a very diversified business is conducted, the relation of fixed to variable expenses is strikingly similar, but this relation does not apparently hold quite so uniform for the medium and smaller ones, which is largely due to the fact that in a smaller community conditions may exist whereby the municipality may be paying a higher rate for power or may serve some industry with a relatively large amount of

DIVISION OF EXPENSES FOR LIGHTING

Fixed expenses	$62,326.00
Variable expenses	98,925.00
Per cent. of Fixed expenses	39
Per cent. of Variable expenses	61
Expenses per h.p. of demand—Fixed	$14.65
Expenses per h.p. of demand—Variable	23.30
Fixed expenses per consumer	13.65
Variable expenses per consumer	21.65
Average demand per consumer in h.p	0.95
System demand in h.p.	4,250

DIVISION OF EXPENSES FOR COMMERCIAL POWER

Fixed expenses	$15,003.00
Variable expenses	27,647.00
Per cent. of Fixed expenses	36
Per cent. of Variable expenses	64
Fixed expenses per h.p. of demand	$11.15
Variable expenses per h.p. of demand	20.50
Demand in h.p.	1,350

DIVISION OF EXPENSES FOR STREET LIGHTING

Fixed expenses	$20,170.00
Variable expenses	3,165.00
Per cent. of Fixed expenses	86.4
Per cent. of Variable expenses	13.6
Fixed expenses per h.p. of demand	$63.20
Variable expenses per h.p. of demand	$10.00

From the foregoing it will be seen that for lighting the fixed expenses represent 39 per cent. of the total, and amount to $14.65 per horsepower of system demand per annum, and the variable expenses $23.20 per horsepower. It will, therefore, be necessary in making rates to lighting consumers to recognize the fact that after having determined the demand for its consumers a fixed charge of $13.65 will be required from the average lighting consumer before applying a suitable kilowatt-hour rate in order to obtain sufficient revenue to pay for the variable expenses.

Earlier in the discussion it was mentioned that lighting consumers had a striking similarity to one another. This undoubtedly was true in the early inception of the industry, but to-day many domestic and commercial lighting consumers will have demands approaching from twenty to thirty times what would be required for ordinary lighting service due principally to the use of the many appliances which have been developed in recent years. This brings about a new angle on the matter of rate-making and an equitable method of applying those rates, and it would seem that the only solution in such cases would be to measure the consumer with a demand meter and apply rates based upon the foregoing analysis.

In examining the sub-divided costs for power supplied, it will be noted that the fixed expenses represent 36 per cent., and the variable expenses 64 per cent.; also that the expenses per horse-power of system demand represent $11.15 per annum.

The present system of billing power consumers is based on demand or connected load, and appears to be equitable, as is shown from the analysis, especially when the actual demand has been measured. In street lighting the fixed expense represents 86.4 per cent. of the total, and in this class of service there has never been a deviation from the original method of assuming street lights on a demand basis.

CONCLUSION

In analysing the general field, especially with reference to the users of commercial power, the Superintendent or Manager is sometimes reluctant to deviate from the practice of billing his power consumers on an installed capacity only, largely from the fear that if a demand meter were installed the revenue from the contomers would be less. In reference to this question an analysis was made

TYPICAL INSTALLATIONS OF WHERE MAXIMUM DEMAND METER WERE USED

Number	Connected Load in h.p.	Maximum Demand in h.p.	Per cent. connected load
1	70.0	13.5	19.3
2	35.0	19.7	56.3
3	52.5	10.1	20.0
4	221.8	64.0	28.9
5	35.0	22.0	63.0
6	437.6	204.0	46.7
7	266.9	108.0	40.4
8	80.3	33.6	41.2
9	970.0	535.0	55.2
10	160.0	44.0	27.5
11	219.5	143.0	65.3
12	21.5	17.5	81.3
13	36.1	20.6	57.2
14	46.0	34.0	74.0
15	110.0	92.0	83.5
16	76.0	29.0	38.0
17	50.0	23.6	47.0
18	51.75	45.0	88.2
19	238.0	72.0	30.2
20	111.5	53.0	47.7
21	81.7	36.0	43.8
22	262.5	95.0	36.3
23	371.2	190.0	51.2
24	68.0	17.5	25.7
25	81.75	31.5	38.4
26	30.6	37.5	122.5

of twenty-six power consumers all in one town showing the connected load and the maximum demand to illustrate their relationship to each other.

From the foregoing it will be seen that in a great many instances the installed capacity is much greater than the maximum demand, but in reviewing each case it was found that the industries served were very diversified in their activities, and most plants were modern in that they had installed individual drive as far as possible. Also it will be noted that there is no fixed relation between the maximum demand and the connected load ; therefore, had these customers been billed on an installed capacity there would be many cases of billing which would not be equitable to one another : for instance, consumer No. 26 had an installed capacity of 30.6 horsepower and a maximum demand of 37.5 horsepower, whereas consumer No. 4 has an installed capacity of 221.8 horsepower and a maximum demand of 64.0 horsepower. It would obviously be unfair under conditions of that kind to have billed these consumers on a connected load basis.

Billing on a maximum demand basis has the incentive, on the part of the customer, to create a better load factor than if on the installed capacity, which results in lower capital cost in the way of transformers and lines to serve the consumer, and a better control of peak. A number of instances have been observed whereby the installation of a maximum demand meter, especially on chopping mills, has forced the consumer to control his peak to within reasonable limits, increasing his load factor and at the same time putting his industry on a profitable basis rather than a losing one.

Discussion

Mr. W. R. Catton, Brantford :

We have learned considerable valuable knowledge regarding the measurements of loads ; but, in my estimation, one of the most important loads as yet unmeasured is the heating or cooking load. Nobody, as yet, has made any effort to measure it or control it, and sooner or later we will be forced to take really serious steps to cope with the situation. In Brantford, we have a cooking demand for the noon hour meal of at least 1600 h.p. This demand exists from eleven-ten to twelve o'clock. Why should we allow flat-rate water heaters ? Why not install a simple, cheap and rugged relay on the circuit. Then, instead of just collecting enough money from it to pay those h.p. charges to the Hydro-Electric Power Commission, you will collect enough to provide an additional revenue, the same as the Electric Power Commission is doing, and we can make the water heating rates lower to some extent, and fill in the valleys caused by the electric stove. Six hundred watt heaters on a relay should pay for themselves in about six months.

Mr. E. V. Buchanan, London :

Mr. Catton referred to the matter of using a relay to take the flat rate water meter off the peak when other appliances were being used in the

residence. The unfortunate thing about that is that it does not altogether remove the water heaters from the peak; that is, from the station peak. It will remove the water heater from the peak of the individual service; but you may have a case in one house where, at the time of the station peak, the consumer is not using the stove, and therefore the water heater is still on the line; whereas the next door man has a water heater and no stove, and the water heater, in that case, is on the peak. Apparently, Mr. Catton wants to make a lot of money out of the water heaters; but I do not believe we are in business to make money out of anybody. I am of the opinion that the water heater load is an excellent load. There are many loads that we have on our system that we do not get nearly so much revenue per horse power as from the flat-rate water heater.

Mr. Catton:

I naturally expected Mr. Buchanan to speak the way he did. The water heater in our town anyway certainly does come on the peak, and my ambition is not to make a lot of money out of the water heater, but to make the flat rate water heater cheaper to the consumer. If we could get it off the peak, we could get it cheaper, and it certainly will come off the peak if we put a relay on it.

Mr. A. G. Grier, Canadian General Electric Co.:

Mr. Catton's question may be answered by either installing a demand meter that will make the man pay who is willing to pay for what he gets, as against the other man who is watching his load, and doesn't want to pay too much, or to put in one of the peak limiters. There are peak limiters on the market, and others coming on the market, and I believe the situation will be taken care of by either of those two devices.

Mr. C. W. Baker, Packard Electric Co.:

Anything which makes the rate more equitable to everyone concerned, by those supplying power, as well as those using it, must be of benefit to the whole community, and must reflect itself in better rates to everyone. I am speaking especially of the rate regulating relays which are now coming on the market. While it is a very nice idea to be able to pull off all water heaters at the discretion of the operator when the peak load comes on, that is not yet available. This other is available and is bound to reduce the total peak of the community, and I think, if we analyze the situation on, say, a 750-watt heater, and the approximate power cost to the cost of your relay for the year, you will find that you have cut that heater out of the peak, and each relay which you have installed will save you what you are paying per horse power for the power. At the end of the year, you will find your relay completely paid for at the present rates, and possibly something to spare, so that you will be giving a fair rate to everybody; and while it may possibly work a little hardship to one or two, it will be to the benefit of the community in general.

Mr. J. E. B. Phelps, Sarnia:

We are in a business whose duty it is to serve the public, to give them something that they want and when

they want it. I do not think it is our business to tell people when they are to use the power. I think it is our business, possibly, to bring in a demand meter, and let the people who are willing to pay for what they use pay for it. I think the idea of trying to isolate certain kinds of services by saying we are losing money on this or making money on that can be carried too far. Go into any other class of business, and you will find a merchant possibly carrying some stock, and selling it at a loss, but on the aggregate, why, he is making some money. If he isn't, he goes out of business.

Mr. Catton :

A relay restricted water heater load does not amount to anything beyond possibly twenty-two hours out of twenty-four. If possible, instal a covering on the tank and water heater, similar to the one Mr. Buchanan sells, and the interruption will not be serious. If you can give the man the power and the interruption doesn't amount to anything, he will appreciate it.

Mr. F. T. Wyman, Packard Electric Co.:

I believe what has been mentioned about relays does not cover water heaters only. There are other things entering into it, non-essential loads such as electric heaters in the Fall of the year, which are apt to be turned on when the range load is on ; also electric refrigerators, and other things like a fire alarm, and I believe those are cases which are outside the peak at certain hours. With the relay you can turn off, not only the water heater, but some of the non-essential loads that do not need to be on when the cookstove is in full use.

Mr. E. I. Sifton, Hamilton :

Recently, in discussion with the Ontario Commission, in connection with the sale of a fairly large contract for power, it was shown that Niagara power has been generally sold without consideration of load factor. The new power from the Gatineau is bought on a weekly load factor, and we were politely and quietly warned, if we got too high a load factor on our system, they would start billing us on a kilowatt-hour basis instead of a demand basis. That may put a little different complexion on the question of selling power on the demand basis. We want people to keep off, just as much as they can, but have all the conveniences possible.

Mr. J. H. Caster, H.E.P.C. of Ont.:

We are not going to try and stop the woman using her electric iron when she wants to. We cannot. And another thing that is lost sight of, as soon as you get a 100 per cent. load factor, you have got a zero diversity. After all, if we let things run as they always have, because we cannot stop them, we find that we get pretty fair results. We have a very good diversity. We have a very good load factor. We have very good conditions. Women do their ironing when they wish. All that is necessary, of course, is for the Hydro Commission to remain in its present high status, and just merely separate the equitable and it will be all right. And although there might be some field for a limiting device, my own opinion, and my observations, lead me to think that, if we just keep equity and

let everything go along—in other words, wait and see—we will find things are not too bad. There is this point Mr. Rothwell brought out in his paper which must be remembered: that at least one-third to one-half the cost is a fixed charge, and to be equitable, we must base our rates on demand. We should, I believe, collect most of our service charge as a service charge ; but we will have to have a principle of basing all our rates, even down to the domestic, on a demand basis, if we are going to be equitable. It has been suggested that all three-wire services have a demand meter. Two wire services don't need it. I would like to bring that point out as squarely as I can, that in order to be equitable, you have got to have the billing on a basis of demand.

Mr. H. J. MacTavish, Toronto :

Mr. Rothwell divides his costs into fixed and variable costs, and I notice that he puts his power purchased among the variable costs. Now, power purchased is a fixed cost, when the power is developed hydraulicly ; that is, practically 99 per cent. of your cost are fixed charges. On your generating plant, and your transmission lines, the operating cost is very small compared to fixed charges, and therefore, dealing with hydraulic power, you have got to include the power purchased. There is a division that he does not make. That is, a division between what might be called customers' cost and demand cost. Customer cost covers your meters and services, both the operating and fixed charges, plus your billing, meter, reading, inspection, and so on, and, roughly, amounts to something in the order of sixty cents a month. When you get into the steam plant, you do get a degree of variation in the power purchased, because the item of coal varies with the hours of use. Now, the demand cost is variable to this extent ; that you have different load factors, and the Hopkinson rate takes account of the variations in the load factor. That is the function of the Hopkinson rate as I see it, and that is the basis on which the demand meter is equitable. There is one point about the Hopkinson rate. All rates are bound to work inequalities to someone ; and the Hopkinson rate works an inequality in that there is no feature about it to register the time at which the demand occurs. There is no doubt a customer could be served at a lower cost, if he would take his demand between the hours of twelve and one, or after twelve o'clock midnight. But there is no allowance for that in the Hopkinson rate. There is an attempt, in our power rates, to take care of the long hour, or, rather, the customer who stays off the peak, by giving various discounts. But that is not extended to commercial customers. The commercial customer is supposed to be a twenty-four hour customer, and yet, there is no doubt about it, there are a great many commercial customers whose loads correspond exactly to the ten-hour power customer ; and there is no reason that I can see why their power is not as cheap, say, as the power customer who starts in on the residence lighting power at night. In connection with the difference between the installed load and the demand, there is no question there

will be a loss when demand meters are installed. I think that, in view of the fact that it is more equitable that that loss should be taken and the rate adjusted.

Mr. Rothwell :

I might say a word about Mr. Buchanan's remarks. They are not having difficulty in applying the Hopkinson rate. The Hydro Commission have already applied it to some twenty-five thousand rural consumers, without difficulty. I think that is a matter of education.

There is one thing, in reference to Mr. MacTavish's remarks. If you put a demand meter on a domestic consumer, the first thing you will find is that the general peak on your system will tend to flatten out, because that consumer will, in time, become familiar, to some degree at least, with the function of that demand meter, and will attempt to cut down excessive peaks, therefore improving the general load factor of that particular system. I think that is an important thing, especially in the month of October, when the business of seasonal appliances, such as electric grates, and the electric stove to warm the kitchen in the morning, comes on, and which gives the Hydro Commission their peak for the year. Now, it costs you people a lot for the Hydro Commission to have a peak in October, because it means the Hydro generators are idle during quite a number of months in the balance of the year, and if the customer knows he is going to pay extra by virtue of him creating an excessive peak in October to warm up his residence, he is going to be cautious in the use of those appliances at that particular season, and in consequence of which those Hydro generators will not be quite so idle during the rest of the year.

Kitchener Hydro Shop Window during Hydro Silver Jubilee Celebration.

Grounding

By E. M. Wood, Electrical Engineering Dept., H.E.P.C. of Ont.

(Read before Association of Municipal Electrical Utilities at Niagara Falls, June 23rd, 1927).

THE chief functions of grounding are as follows :

To protect persons from dangers arising from electrical sources. This involves :

Grounding of exposed non-current carrying metal parts of electrical equipment or appliances.

Grounding of metal parts so located with respect to electric circuits that they are liable to come into accidental contact with the circuit and so become alive.

Grounding of low voltage distribution circuits—chiefly the "neutral" wires of 110-220 three-wire secondary distribution circuits.

These grounds are usually called "Safety" or "Protective" grounds.

To protect the insulation of circuits and apparatus against destructive overvoltages produced by lightning or similar causes. This is done by installing lightning arresters through which these overvoltages may be discharged to ground. The ground connection for this purpose is usually called an "Arrester Ground".

To increase the continuity of service in the operation of electric systems by grounding certain points in electric circuits such as the neutrals of generators, motors, transformers and the like. Such grounds are called "Power Grounds".

An object or a circuit is "grounded" by connecting it by means of a suitable wire or cable conductor which we will call the "ground lead" to a metal device, to be called the "ground electrode", embedded in the earth. The "ground lead" and "ground electrode" will herein be collectively called the "ground connection". Every connection between electric circuits and ground or near-by conducting bodies will be referred to as an "accidental ground".

In this discussion we are principally interested in grounding for personal safety. Lightning arrester grounding is well covered in a publication entitled "Lightning Arrester Grounds" by Mr. H. M. Towne.[2] Power or Neutral grounding has been much discussed by various technical societies and is of more interest to designing and operating engineers. We are here interested in power and arrester grounds chiefly in so far as they affect personal safety, which they do to some extent.

It will be of interest to consider briefly just why connection of objects or circuits to ground should enhance safety of persons. Against what dangers are we trying to guard, and how does grounding accomplish it ?

It is known from experience that a comparatively small voltage between two conductors will cause severe shock or death to a person who spans them with parts of his body. We have practically everywhere the earth or ground which is a conductor of electricity with the following in-

teresting characteristics : It is, as a whole, a good conductor of electricity; so good, in fact, that except for certain very local disturbances which we will consider later, it is at a uniform electrical potential because potentials in the earth tend to come to a uniform value, and there is no considerable resistance to hinder this tendency. We consider the earth as the standard of electrical potential and call this "*zero* potential".

Every object capable of conducting electricity if touching the earth or connected to it by any sort of conductor is at earth potential and will remain practically at that potential while carrying the very small current necessary to severely shock or kill a person. In other words, earth potential is practically everywhere so far as danger of a person spanning between it and a live electrical conductor is concerned.

Every energized electric circuit and conductor has a potential against earth, except of course those grounded conductors which are carrying no current. If the system is grounded, an "accidental ground" on another conductor will allow all the available power of system to supply current at the contact. Even if the system is ungrounded, the energized conductors act as plates of a condenser with the earth, and an accidental ground will discharge the condenser or pass its charging current through the contact on an alternating current system. The amount of condenser current which would flow depends on the physical construction and voltage of the line. With a 2,200 volt system one mile long about 10 milli-amperes condenser current could be expected to flow at 60 cycles, plus any leakage current due to imperfect insulation.

Thunder clouds are charged with potential against earth which tends to discharge to earth, and which does so in the lightning stroke.

From these it will be seen that a person, touching an electric circuit at dangerous voltage and any object at earth potential, will be in danger.

It is a cardinal principle of safety that known dangers can be safeguarded, and that it is the unsuspected danger which is the greatest menace. Power conductors of dangerous voltage are usually well marked and people avoid them, or if they have to work on them they take care to be well insulated from ground while doing so. However, these same conductors are separated by insulation from such metal parts as frames of equipment, by space or insulators from building frames, walls and fences. In distributing transformers, the low voltage secondary circuits which come into our houses are close to dangerous high voltage windings. Insulation breakdowns occur, and conductors become misplaced so that objects, circuits or appliances which are customarily handled with perfect safety come suddenly and probably without warning into contact with the high voltage conductor and become highly dangerous. This then is the very real danger against which we endeavour to guard by "grounding" them so that they will remain at ground potential, and therefore be safe no matter what happens. When dependence is placed on grounds for this purpose they must be carefully made, because if poorly made or

inadequate for the purpose loss of life or serious injury may result.

The ideal condition of maintaining grounded objects at exactly ground potential is never quite realized because certain factors enter, tending to allow the potential of these objects to be raised above ground potential.

Some of these are :

The ground connection may have to carry current, in fact, it usually does in case of a breakdown of insulation. This current may be as much as the full amount of current the whole system can deliver to a fault at the point. In the largest stations this may be thousands of amperes. In remote installations it may be small. The maximum possible amount of current which can flow can usually be estimated with fair accuracy if the details of the system are known.

The resistance of the ground connection is never quite zero as will be seen from data submitted below.

The voltage rise of the grounded object above ground potential will be equal to the product of ground current in amperes times the resistance (strictly speaking, the impedance) in ohms of the ground connection. For safety, this product (IR) must be kept below a value which is dangerous to life, and which is usually fixed at 150 volts, although at times even this voltage may be dangerous.

When dealing with lightning arrester discharges, the ground connection carries currents at high frequency, and the impedance of the ground lead against this current is much higher than its ordinary impedance or resistance. Moreover, these disturbances travel with a very steep wave front so that the combined result is that a high voltage may be developed in a very few feet of the ground lead when handling arrester discharge. One advantage here is that the disturbance lasts only a small fraction of a second, though there may be a succession of discharges.

The effectiveness of the grounding is lost if the ground connection is broken by fusing, corrosion or mechanical or other injury or by considerable increase of the ground resistance.

The Ground Connection

It will be seen from the foregoing considerations that the ground connection must have the following characteristics :

It must have permanently the lowest feasible resistance to ground. For safety, this should be less than 150/I where I is the maximum current which is likely to flow through that ground connection.

The electrode must have sufficient capacity to discharge the necessary current without being damaged or the resistance increased above the maximum.

The ground lead must have sufficient carrying capacity that it will not open up when carrying maximum available current. Provision should be made for testing. In important installations where the additional expense is warranted there should be at least three ground electrodes, temporarily separable from each other to facilitate measurement of ground resistance of each and all.

Ground Electrode

Table I gives the results of measurements of the ground resistance of

actual ground electrodes made in the summer of 1926 at a number of the Commission's stations, varying from large transformer stations to pole metering stations.

Table II gives a summary of the results of tests made by the Distribution Section on a number of single pipe grounds at various locations, also the effect of temperature and salting on the resistance.

From these tests and from others that have been made, we draw the following conclusions regarding ground electrodes.

Individual cases of high ground resistance are reported from all types of grounds, which shows that there can be no assurance as to the effectiveness of a ground unless its resistance is measured.

It is that part of the surface of the metal electrode against which the earth is packed tightly and which is in moist, unfrozen earth which is effective in conducting current to ground.

The total resistance of the ground connection is made up of the sum of the resistance of the lead, the electrode, the contact resistance between electrode and earth, and in the earth near the electrode.

Tests show that for ordinary power frequencies, the greater part of this occurs in the earth adjacent to the electrode. The actual contact resistance is small if the earth is packed tightly. The conductivity of the earth is chiefly in the chemical compounds held in solution in the moisture of the soil, and if the moisture is absent the resistance will be high.

Frequently the best electrode to use is an extensive buried water piping system if such is available. Because of the amount of surface buried in the earth below the frost line, it usually has a low and permanent resistance. If a water pipe is near the installation, it is dangerous not to connect it to the grounding system because it will have true ground potential and there might be a dangerous voltage at times between it and any less perfect electrode, unless they are metallically connected together. For house or power service and other small installations, grounding to water piping system should be sufficient. For larger installations, the piping system may not have sufficient capacity and should be supplemented by other types of electrodes.

Distribution neutral and transformer secondary circuit neutrals are usually, in our systems, connected to the same wire and grounded at the transformers, giving the net result of a large number of grounds in multiple. You will notice that the total resistance of these neutral wires to ground as measured at the station is almost invariably low. For this reason the neutral wire forms a valuable ground electrode for station grounding and should be connected to the station grounding system. It should therefore be brought back to the station power bank and connected to the neutral of the bank, and a tap taken to the station grounding system. This gives a direct metallic return to the transformer neutral, and to a large extent relieves the station grounding from carrying unbalance or fault current, which might cause dangerous potential at the station, and probably will do so at some of the distribution grounds.

Transmission line sky wires, which are grounded at each steel tower, and at intervals on wood pole lines show, on account of the multiple grounding, low but somewhat erratic total resistance to ground, and it is worth while to connect them to the station grounding system, as this improves both the grounding of the station and of the skyline.

During lightning disturbances, the sky lines may have to carry high frequency voltages similar to those on the arresters, and they are best connected to the special arrester grounds. However, if a station has extensive steel framework thoroughly tied to ground, the sky wire could be connected to this steel.

While distribution neutrals and sky wires form useful ground electrodes for station grounding, either of them is exposed to danger of cutting or breakage, which would destroy their value as grounds and therefore should be supplemented right at the installation by some other device. The most usual form is the driven pipe or rod.

Driven pipes or rods are used as the principal grounding electrodes at most installations. The reason is that where there is sufficient depth of earth to use them, they form the most economical type of electrode available, as the material is inexpensive, and the cost of installation low, no excavation being required.

Driven pipe grounds have these advantages :

They are cheap to install.

They are little subject to deterioration and if properly installed, are easy to test and maintain.

They can usually be installed where you want them so that the connections are short and can be protected. While a single pipe may have a high resistance, this can be decreased by connecting other pipes in multiple with it to as large a number as is required to obtain the desired resistance.

If it is not feasible to drive sufficient pipes to give the desired low resistance, recourse can be had to keeping the ground moist or treating it with a chemical solution to reduce the resistance.

Driven pipes in good clay or loam usually give satisfactory grounds. In sand, gravel, boulder clay, backfills or other loose soil, also, of course, in rock, it is more difficult to get satisfactorily low resistance by driving pipes.

Where pipes cannot be used, some type of buried plate or metal device is usually used.

An excavation is usually made in which the metal is placed surrounded by soil, or coke and soil, rammed hard against the metal. The lead must be connected to the electrode in such a manner that it will not corrode. There should be provision for keeping the plate moist. If the plate is under water, provision must be made to prevent the soil from being washed away. Where the soil is very shallow, probably the best results are obtained by burying strips of copper or galvanized iron, say 2 in. by $\frac{1}{8}$ in. by 15 to 20 feet long in trenches in the soil. Soil must be rammed tight and if possible kept moist.

For descriptions of some successful plates, see "Plates" in Table I.

RESISTANCE TO GROUND OF GROUNDING ELECTRODES

TABLE. I.

DESCRIPTION	RESISTANCE OF ELECTRODES-OHMS	REMARKS
Water Piping Systems	7.5 - 2.9 - 2.5 - 1.5 - 1.5 - 1.1 - 1.1 - 0.2 - 0.2	
Distribution and Service Neutrals	254 (single pipe) - 28.6 - 18.9 (both in shallow soil on rock) - 6.2 - 4.4 - 4.1 - 4.1 - 3.1 - 3.1 - 2.7 - 2.6 2.5 - 2.4 - 2.4 - 2.0 - 1.6 - 1.6 - 1.5 - 1.2 - 1.1 - 1.1 - 0.8 - 0.6	4000 V. and 110/220 V. neutrals — chiefly in village systems
Transmission Line Sky Wires	30.0 - 27.0 - 25.4 - 20.5 - 19.1 - 17.4 - 16.8 - 16.7 - 16.6 16.5 - 14.7 - 13.6 - 10.5 - 9.0 - 7.4 - 7.0 - 6.1 - 6.0 - 6.0 6.0 - 6.0 - 5.5 - 5.4 - 5.2 - 5.2 - 4.4 - 3.3 - 1.9 - 1.3 - 0.7	
Ground Plates	3.7	in swamp
	5.8 - 7.8 - 10.8	in clay
	7.5 (moist) - 25.0 (dry)	in sand
	54.0 (wet weather)	in gravel
	98.0 (cone)	2 feet sand on rock
	0.6 - Plate placed in forebay, covered with bags of loam, then bags of rocks, then large rocks. Native rock has streaks of haematite	
	2.0 - Consistant resistance of each of several wire loops placed in rock recesses in the forebay, covered with packed soil, then rocks.	
Driven Pipes Multiple:	16.8 (3) - 14.8 (4) - 11.5 (3) - 11.5 (3) - 10.3 (4) - 7.9 (4) - 6.4 (3) - 6.4 (3) - 52 (4) - 5.2 (4) - 5.2 (4) - 2.6 (4) - 2.6 (4) 2.5 (4) - 2.1 (4) - 2.4 (4)	Depth - 6 feet. - Clay Figure in bracket indicates number of pipes in parallel.
	108.0 (2) shallow soil - 92.0 (2) - 30.8 (2) - 25.6 (4) 24.7 (2) - 22.3 (5) - 10.3 (4) - 9.5 (6) - 7.1 (7)	Sand.
	18.5 (4) - 18.3 (4) - 17.4 (4)	Gravel
Single:	36.5 - 30.9 - 23.4 - 20.6 - 20.4 - 17.6 - 15.0	Clay or clay loam
	227.0 - 103.0 - 45.5	Boulder clay
	360.0 - 230.0 - 204.0 - 200.0	Shallow clay on rock
	115.0 - 109.0 - 97.0 - 97.0 - 83.0 - 74.0 - 43.0 - 43. - 28. - 26	Sand or gravel

It has been stated that the most of the resistance in the ground connection lies in the earth near the electrode. This is especially true if the conducting surface of the electrode is small, as in case of a pipe. The cross section of earth through which the current must pass is small at the pipe and increases proportionately to the distance from the pipe. The earth path as a conductor therefore has the highest resistance and steepest voltage gradient at the pipe, and this decreases with distance from the pipe. Tests show that if the pipe is carrying any considerable current, about 90 per cent. of the voltage from the electrode to true ground potential lies within a radius of six feet from the pipe, and most of that in the first foot or two. For example, if a ground pipe at a pole

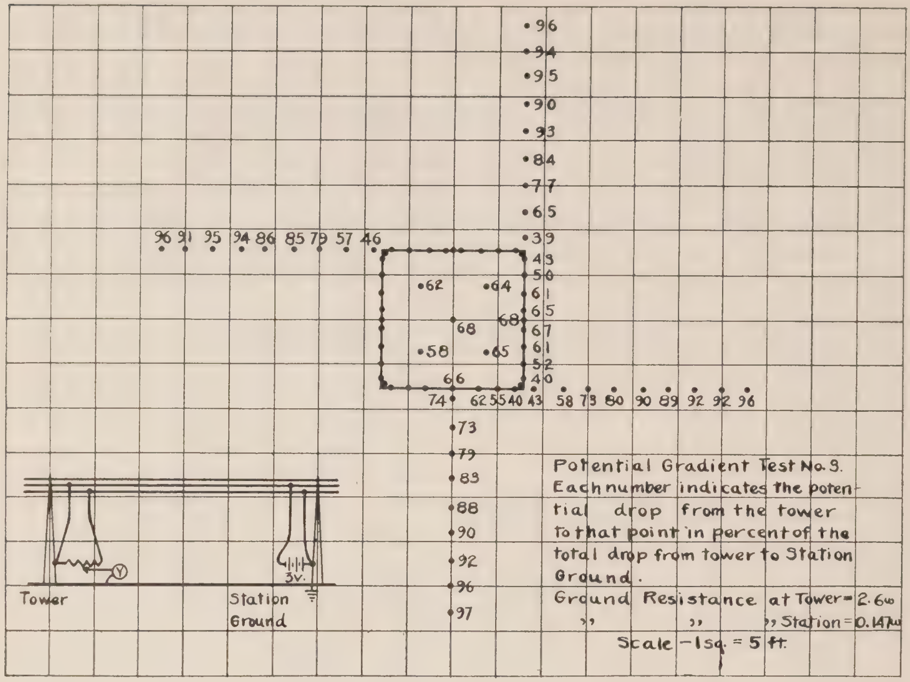

Fig. 1.

has a resistance to ground of 25 ohms and due to a fault somewhere, 40 amperes are flowing in the ground connection, the pipe voltage above ground will be 40 x 25—1000 volts, and a man standing with one foot at the pipe and the other 24 inches away would be subject to 600 to 800 volts between his two feet, which would probably surprise him. Fig 1 shows the distribution of potential between a steel transmission tower and ground. Fig. 2 shows a potential gradient from a driven pipe.

The current carrying capacity of the ground connection in general will be found adequate if the resistance requirements are met. A 1 in. ground rod driven 6 feet will dispose of from 5 to 20kw. of energy without baking out the soil, but if over 8 to 10 kw. are to be handled the installation should be tested out with current.

Design of Ground Electrode

While the object to be attained and the governing principles in designing a ground electrode are the

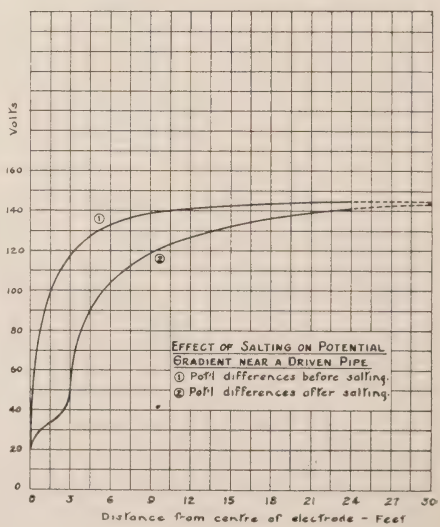

Fig. 2.

same in every case, there will be a gradual variation in details between the grounding at large stations, down through smaller stations to distribution systems and services.

The problem of grounding at *large stations* is characterized by :

Grouping into small area of much expensive electrical equipment and many circuits, failure of which would cause widespread loss of service.

Presence in this area of high voltage with possibility of heavy currents, especially fault currents to ground.

These conditions warrant some expenditure to install an efficient grounding system.

Of course, the smaller the station, the smaller are the voltages and currents to be handled, and less expense is warranted, until in the smallest pole type stations the problems merge into those of the distribution system.

The problem of grounding on the Distribution System or at Services has the following characteristics :

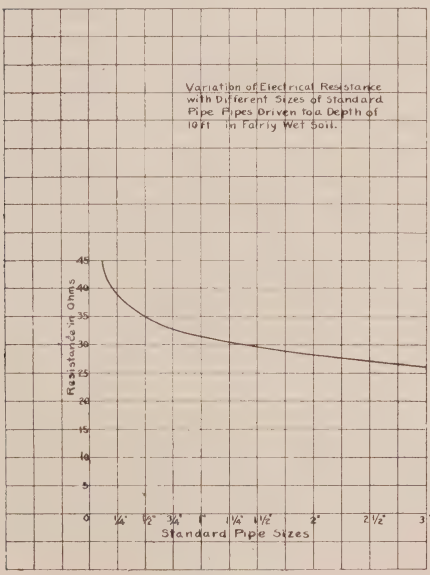

Fig. 3

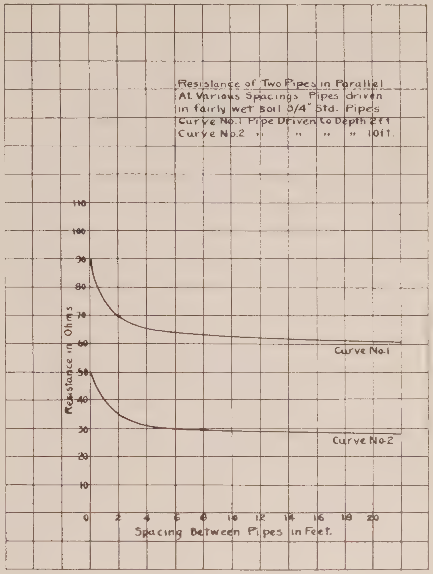

Fig. 4

Lines and equipment are scattered over a large extent of territory.

The energy handled at any installation is relatively small—so that the cost of installation and maintenance of grounds becomes important. At the same time, the number of persons who come in contact with distribution circuits, household appliances, motors and similar equipment is very great, and any deficiencies in the grounding on these widespread systems may have serious results. The problem of effective grounding on distribution circuits at an expense which can be afforded is of extreme importance.

Maximum Allowable Ground Resistance

In large stations considerable expense is warranted in the endeavour to bring the total groundresistance below *one* ohm. I would put *two* ohms as an absolute maximum for a large station. I would also say that *no* station should

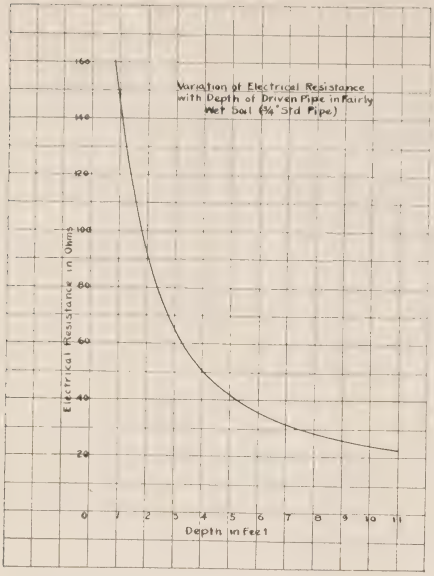

Fig. 5

have a total ground resistance over *ten* ohms and this should be much less if possible. If it is impossible to get within these values at any reasonable cost, the best thing to do is to establish a unipotential zone by installing a number of electrodes on the various sides so that even if the earth at the station is not held at true ground potential it will all be at a uniform potential.

For isolated single grounds as on services, distribution, transformers and the like, it is recommended that where these grounds have a resistance of over 25 ohms, something be done to improve them, by driving additional pipes, by moisture or by salting. Towne[2] states that 15 ohms should not be exceeded for distribution arrester grounds.

Multiple Pipe Grounds for Stations

The pipes or rods should be free from grease or paint, but not necessarily of rust. Iron pipe is preferably galvanized.

Consulting the attached curves[1] we see that :

Three-quarter inch or one inch pipe is the best diameter. (See Fig. 3.) One inch is easier to drive. Five-eighth inch or three-quarter inch Copperweld rods may well be substituted at somewhat higher cost. They can be driven more easily and will be less subject to corrosion.

The pipes should be spaced at least six feet apart. (See Fig. 4).

They should be driven at least six feet. (See Fig. 5.)

The effective part is that in moist, unfrozen earth and for this reason, in many cases, it would be better to drive them twelve feet, but it will often be found difficult to do this. A depth of 8 to 10 feet should be attainable, especially with rods, and is desirable.

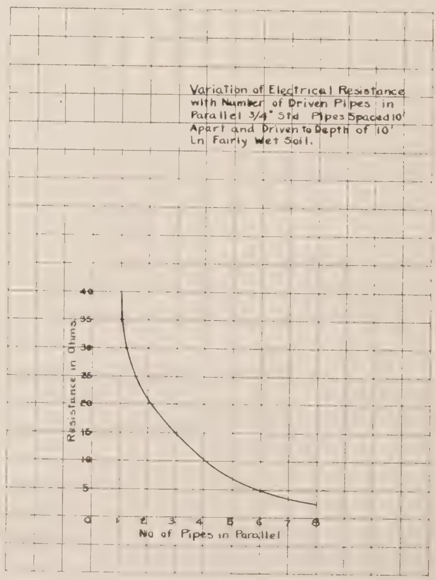

Fig 6

They should be driven in groups of from 4 to 6, usually in a line (see Fig. 6) the pipes of the group being suitably connected together to form one "electrode". Additional similar pipe electrodes should be at least 20 feet away.

It is a good plan to drive the pipes below the ground level, making an excavation about one foot deep at the top of each. In this can be set a concrete box or a tile which will enable the connection to the pipe to be inspected, and will be a good receptacle for water or salt to improve the conductivity. Figs 7 and 8 show the effects of the addition of moisture and salt on conductivity of the soil. Fig. 9 gives an indication as to how long the effects of salting will last. Fig. 10 shows the effect of temperature in ground resistance.

In driving pipes, caps are useful in preventing the top from getting burred and tempered steel driving points will allow the pipe to be driven more easily.

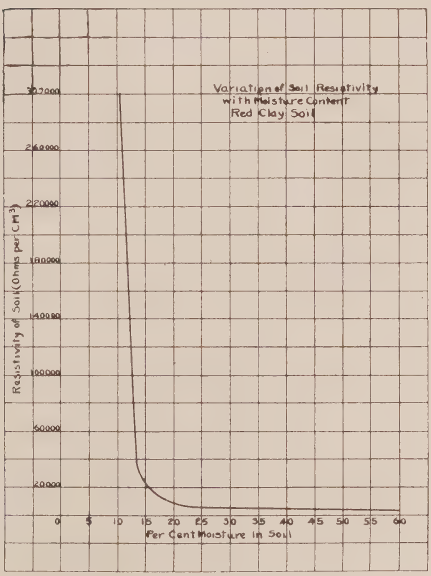

Fig 7

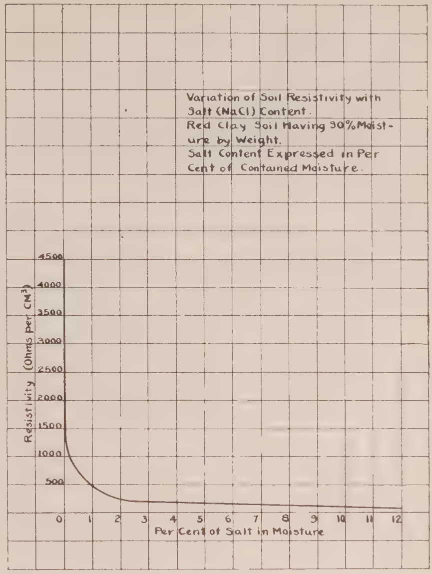

Fig 8

Leads and Connections

The principal requirements of these are :

The lead should have carrying capacity to handle the maximum current to which it may be subjected, without fusing or burning off.

Each joint should be so made that it will not open up under maximum current. It should, so far as possible, be arranged so it can be inspected from time to time.

The lead should be protected, where necessary, from mechanical injury.

The attachment to the pipe or other electrode should be strong mechanically, of permanently low resistance, and protected from corrosion. The best connection to a pipe is some bolted clamp on clean pipe.

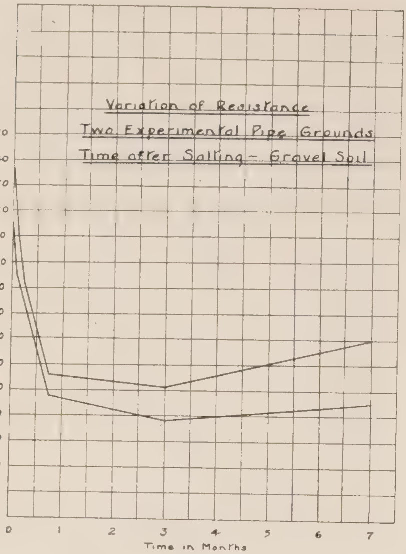

Fig. 9

Corrosion occurs where dissimilar metals are subject to moisture carrying electrolytes, as salt or acid solution. Some protection is afforded by painting the joint after it is made properly tight with pitch or asphaltum to keep out the moisture. Copper sulphate is stated to be somewhat less corrosive than common salt.

Grounding at Stations—Details

These are principally a matter for station designing engineers and we will only touch on a few points.

The best arrangement of a grounding system at a station uses a ground bus system mounted on walls or in other suitable manner to which all exposed non-current carrying metal parts should be connected by suitable taps. To this should be also connected the neutral of the station 110–220 volt lighting system and any power neutral that it is desired to ground. Each ground electrode, including piping system and distribution neutral should be connected to it to obtain the effect of all the grounds in parallel.

Lightning arresters present a slightly different problem. Due to the possibility of impedance drop in the grounding lead, on account of high frequency, a ground electrode (usually driven pipes) should be located near each group of arresters so that the separate ground lead from each arrester will be short and direct. Arresters of widely different voltages are preferably not connected to the same electrode. Each arrester electrode should be connected to the ground bus by a lead separate from the arrester ground lead. Low voltage arresters (below 10 kv.) may well be connected to the station ground bus.

Transmission Lines

Steel Towers.

The danger here is that in case of a flashover to the tower, the fault

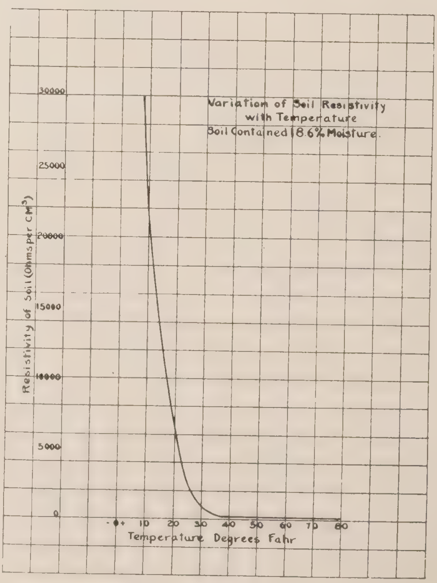

Fig 10

current is conducted down the tower to ground and back to the power house if the transformer neutral is grounded there. This current may amount to hundreds of amperes and if the resistance between the tower and ground is high there is a dangerous gradient from the foot of the tower as shown in Fig. 10. The tower therefore must be effectively grounded either by its own footing or by special buried electrode. Conditions are helped somewhat if a sky-wire connects the towers together, placing their conductivities to ground in parallel.

Sky wires on *wood pole* lines are usually grounded at certain poles (say, every fifth). A customary method is to bury a coil around the butt of the pole. Resistance of these individual grounds is high, but the tests show that the combined resistance is very moderate. It is sufficient to drain off induced voltages from other circuits or from clouds, but a stroke of lightning will probably pile up a high voltage between the ground wire and ground on the nearby poles.

Distribution and Service Grounds

For equipment and circuits on poles, the ground electrode almost universally consists of a pipe or rod driven near the foot of the pole. It should be driven 6 to 10 feet, with preference to the greater depth. Driving cap and point may be used, but the practise of clamping the ground lead under the driving cap has not proved very satisfactory, as the leads have a tendency to break off, possibly due to damage in driving. The head of the pipe is usually left out of the ground a short distance and to it the ground lead is clamped. The lead up the pole should be at least No. 6 B. and S. gauge copper for mechanical strength, and it should be covered on its course on the pole to prevent mechanical damage and to prevent injury to the lineman while climbing the pole in case the ground is handling current or in case it has become detached from the electrode at the bottom.

At a house or power service the ground is preferably made to buried water piping system, but where this is not available a pipe ground should be driven as near to the entrance as possible. The ground lead should be at least as large as the power conductor. It should be protected, and so far as possible, arranged so that it can be inspected readily for continuity.

In case sufficiently low ground resistance cannot be obtained with one pipe, a second pipe may be driven at least 6 feet away and connected to the first. If the resistance is still high, additional pipes might be driven, up to a total of four, or the pipes salted. The trouble with salting is that the salt will have to be renewed in time. Some experiences reported would indicate about every two years as the allowable interval between saltings. (See Fig. 9.) If the pipe can conveniently be located in a permanently moist location, this should be done.

Details of Distribution and Service Grounding

Metering Poles

Grounding here is chiefly to protect the metermen and linemen.

To the ground at the foot of the pole should be connected the meter

cases, conduit, metering transformer cases and secondaries and other metal parts; except possibly the pole hardware which is usually left ungrounded, in which case it must be kept carefully clear of grounded objects. It is a debatable point whether the distribution primary neutral wire, if such exists, should be connected to this ground. The low resistance multiple ground, which it makes available at the metering pole might be of use, if ground conditions at the pole are poor and a breakdown of insulation should occur on a metering transformer. On the other hand, if the neutral wire got broken in the right place the meter pole ground might have to carry fault current alone, or be subjected to lightning voltages giving rise to a dangerous condition which would otherwise be avoided. We believe that where the neutral affords a good ground it is worth while to connect to it. Lightning arresters are usually mounted on adjacent poles, but in case they are mounted on metering poles, they should have a separate ground lead and pipe, preferably on the opposite side of the pole.

Pole Top Disconnecting Switches

Pole top type air break switches present a serious problem as operators have reported severe shocks at times and fatalities have been reported. They usually consist of a framework with a mechanism at the pole-top, connected by an insulating link to an operating handle within reach of ground. The danger is that through leakage or breakdown, the handle may take a different potential from ground. The requirement is to keep the handle at ground potential, which can be done by connecting it to a ground pipe. In case any current is being discharged which raises the pipe above ground potential, it has been suggested that a screen or plate be placed at or just below the surface of the ground, and connected to the ground pipe and the handle mechanism so that the operators' feet and hands will be at the same potential no matter what is happening. This would have to be large enough so the operator can walk off it without danger. The pole top mechanism is best grounded through the primary neutral wire or sky line, if either is available, and not to the ground for the handle, as such a connection would short circuit the insulation link.

At *distribution* transformer poles, the grounding lead from transformer case and secondary neutral should be entirely separate from the arrester ground lead, although both may be connected to the same electrode. The reason is the same as for similar procedure at stations. Also, if a common lead is used it might break away from the electrode and lightning would then discharge direct to the transformer secondary neutral, with serious results.

The primary neutral, when present as a conductor which has been grounded at many other transformers, is usually connected at the transformer to the protective ground. However, if for any reason, grounding the primary neutral will cause the ground connection to carry power current, great care must be taken that the ground resistance is sufficiently low that the (IR) drop is, and will remain within safe value,

RESISTANCE TO GROUND OF GROUNDING ELECTRODES

TABLE II

DESCRIPTION	RESISTANCE OF ELECTRODES-OHMS		REMARKS
Driven Rods 5/8" "Copperweld"	Average of 37 rods = 30.2 maximum = 110.0 minimum = 5.5		6 ft. depth. Tested in November, 1926, after wet season
	Average of 37 rods = 49.1 maximum = 188.0 minimum = 7.9		6 ft. depth. Tested in February, 1927, with average depth of frost 18 inches
	Average increase in resistance from Fall to Winter = 62%		
2-5/8" Copperweld Rods treated with Salt	66.0	150.0	Before treatment.
	45.5	74.7	4 days after " .
	46.7	70.0	With frost in ground. All 6 ft. depth

and in such a case the secondary neutral should by no means be connected to it.

At power and lighting services, all conduit, switch boxes, meter cases, frames of transformers, motors, starters, and other electrical equipment and stationary appliances such as ranges, should be grounded.

There is some question as to whether the secondary neutral of 110–220 volt house services should be grounded. I consider that this should be done at the services as well as at the transformers, to function in case the transformer ground lead becomes broken, and to improve the grounding of the circuit.

Testing and Maintenance

In discussing the reports of Tests, Tables I and II, we pointed out that the only way to be sure the grounding, which has been installed, is effective, is to measure the ground resistance.

The resistance of each ground electrode should be measured and the total ground resistance at the installation calculated and recorded before the installation is placed in service.

After the installation is in service, resistances change under various conditions of moisture and temperature, and ground connections may corrode or be broken or someone may disconnect them and forget to put them back. They should therefore be subject to periodic inspection and test. At important stations, tests should be made yearly and visual inspections more frequently. It should be the duty of some competent person to see that the necessary tests are made and records kept, and that grounding conditions are kept safe.

Measurement of ground resistances requires suitable equipment, and to be accurate requires three separable electrodes. Fig. 11 shows a diagram of the testing circuits used last year in testing station grounds. It re-

Voltmeter-Ammeter Method for Testing Station Grounds *

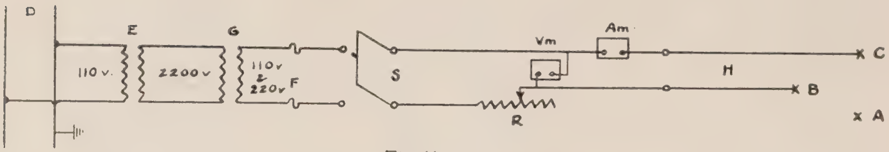

Fig. 11.

D – Station Service Supply
F – Fuse
A & B – Reference Grounds
C – Ground under Test
R – Rheostat to limit current, in case ground resistance is low.
E & G – 1 Kw. Transformers – to isolate ground
H – Test Leads – non inductive, constant resistance – about ·6 ohms each, – 2-*14 B&S, each 500 ft long.

S – Control Switch
Vm – Voltmeter
Am – Ammeter

Solution – sample test

Let Vm reading = V volts, let Am. reading = I amperes

Then Resistance = $\frac{V}{I}$ ohms.

Resistance of A + B = 16 ohms ①

B + C = 18 " ②

C − A = 2 " ③

C + A = 10 "

2C = 12 " or C = 6 ohms.

B = 12 " – substituting value for C in ②

A = 4 " – " " " C " ③

Combined Resistance $= \dfrac{1}{\frac{1}{6} + \frac{1}{12} + \frac{1}{4}} = 2$ ohms.

* Used by H.E.P.C. Testing Staff – Summer 1926

quires three electrodes and gives very satisfactory and accurate results, but is not very portable.

A convenient method where a transformer is available is shown in Fig. 12. This measures the resistance of the ground electrode plus the resistance to ground of the distribution neutral, which is usually low, and is assumed to be negligible.

Fig. 13 shows a Wheatstone, or more properly, a Kohlrausch bridge which can be made in a very portable form. It can be used either to measure the sum of pipe and distribution neutral resistances or if three electrodes are available, to measure the resistance of each. If these are not found satisfactory for testing a

Ammeter Method
for
Testing Station Grounds

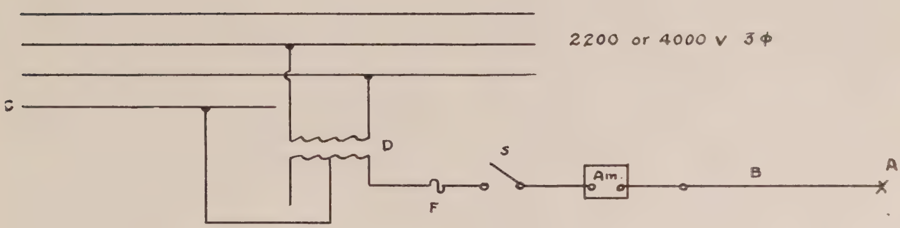

Fig. 12

F — Fuse
S — Control Switch
Am — Ammeter
C — Line Neutral Wire
D — Service Transformer
B — Test lead
A — Ground under test

$\text{Resistance} = \frac{V}{I}$

If ammeter reading is 4 amperes or more, ground resistance is 25 ohms or less. This is an approximate method.

Kohlrausch Bridge Method

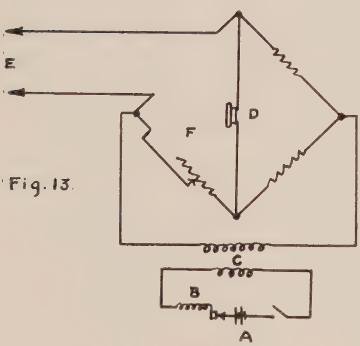

Fig. 13.

A — 3 Dry Cells in series.
B — 4 ohm Buzzer
C — Small Transformer – 1:10 ratio
D — Telephone Receiver
E — Test Leads
F — Portable Wheatstone Bridge.

In making measurements procedure is same as for ammeter-voltmeter method, i.e. 3 ground connections under test
Accuracy – 5%.

large number of grounds with sufficient accuracy, a tester will have to be developed.

REFERENCES :

[1] "Ground Connections for Electrical Systems," by O.S. Peters. 1918. No. 108 Technologic Papers of the Bureau of Standards, Washington, D.C.

[2] "Lightning Arrester Grounds," by H. M. Towne. 1924. General Electric Company Publication Y1949.

Discussion

Mr. Wood:

A little over a year ago, a Committee was appointed to investigate the characteristics and proper uses of driven pipes for grounding, and the question of grounds in general. The Committee has held several meetings, and has made some experimental investigation on driven pipe grounds, especially as applied to distribution systems. Also, during the summer of 1926, under the direction of Mr. D. A. McKenzie, of the Operating Department of the Commission, careful inspection and tests of grounding conditions were made at a large number of the Commission's stations, varying from the large transformer stations to even some of the smaller pole metering stations, and a good deal of information and data was obtained. The results of this inspection were available to the Committee; and, based on that, the Committee have made some recommendations to the end of improving the grounding conditions. One of the recommendations was that a paper be prepared and presented at this Convention. This paper has been put together with the collaboration of the Pipe Grounds Committee, to whom the writer is indebted for valuable suggestions and criticism. The paper, as will be noted, is intended to cover the principles underlying the practice of grounding, the elements which enter into it and sufficient recommendation to provoke discussion at this Convention, and bring out various viewpoints and experiences to lay the foundation for intelligent and successful application of specifications which may be issued.

Mr. S. W. Borden, Crouse Hinds Company:

Mr. Wood's paper is certainly a much needed contribution to a subject upon which only too little has been written and certainly adds considerably to our available fund of knowledge on the subject. It is in fact rather astonishing that there is so little to be found in writing upon the general subject of grounding.

Coming as it does just at this time when the Canadian Electrical Code is in the making, it might perhaps be wise to discuss as fully as possible those portions of the paper which touch upon subjects which no doubt will be treated in the code.

On page 273 Mr. Wood suggests that the ground lead should be at least as large as the power conductor. So far as the ordinary run of installations is concerned, I believe that so long as we require a No. 8 B. & S. minimum, it is not necessary that the ground conductor be so large, and probably a capacity of 1/5 that of the largest conductor of the service is sufficient for all practical purposes, providing it is properly installed, and it is important to keep the size down as much as possible for the sake of economy. Many of our modern grounding regulations require the copper conductor grounding the circuit to be enclosed in rigid conduit throughout its entire length, from the switch box to the water pipe, and connected to the conduit at both ends. A No. 8 copper conductor, before fusing, will carry close to a thousand amperes long enough to put out a fuse or circuit-breaker, and when it is installed in a ½-inch con-

duit, and joined to the conduit at both ends, thus placing the conductors in multiple, the combination of the two will generally throw out any trolly circuit-breaker in case of a cross with a trolly wire even though the breaker may be set as high as 3500 amperes. Taken all together, it would seem as though an unnecessary burden would be imposed by requiring that the ground conductors be of the same size as the service conductors.

On page 275 the author raises the question as to the necessity of grounding each individual service at the customer's main switch, stating, however, that it is the committee's opinion that the service should be so grounded, or at least that is my interpretation of the second paragraph on page 275. He goes further, however, and says that this arrangement improves the grounding of the circuit, which, of course, is a pretty broad statement, and it might perhaps be well to point out a few ways in which grounding at the main switch is better than grounding at the pole.

As I see it, there are quite a few reasons why this is true. If the ground is at the pole the entire service wire from the ground at the pole to the customer's main switch is part of the customers' protective grounding circuit, and since it may be anywhere from twenty-five to several hundred feet from the customer's main switch to the street and anywhere up to a thousand feet along the street itself before you reach the particular pole where the ground is installed, it may readily happen that there are several hundred feet of wire in the ground circuit, which makes it a very poor ground conductor indeed, both because of the high resistance of circuit and because of the possibility of its being open circuited, in cases of storm, etc., which is just the time when it is most needed. A very good motto to bear in mind in grounding is, "The closer the better." Another reason is that the chance of getting a water-pipe ground is very much better on the customer's premises, and a water-pipe ground is worth going after. In fact grounding to water pipes should be compulsory when they are available. Still another reason is the multiplicity of grounds obtained by grounding at each installation, and last, but not least, if the protective circuit is installed on the customer's premises it becomes part of the wiring, and is put in by the electrician along with the other work, and it is therefore subject to inspection and approval by all parties having jurisdiction over the wiring, as well as to the approval of the utility supplying the current.

Another phase of grounding, and one which is a very live one at the present time, is covered by the first paragraph on page 275, namely, the grounding of the metal enclosures and frames of utilization equipment. It is certainly highly desirable that such enclosures be grounded, irrespective of the voltage of the circuit on which they are used, and I am rather surprised that the author has limited his recommendations to stationary appliances. The constantly increasing use of electricity in industry, and the increasing contempt for the danger associated therewith which is usually bred by constant use, is making the grounding of enclosures of all portable

appliances used in industry increasingly necessary. Nor should this grounding be limited by any means to voltages higher than 110 because there seems to be little doubt that many workmen are being fatally or seriously injured as the result of receiving a shock from a 110 volt circuit. The current itself is not always responsible for the injury. It is often the shock which results in the workman being thrown from the ladder or losing his balance while working in dangerous positions around moving machinery, over open vats, etc. It is little less than criminal, for instance, to send an unskilled laborer into the inside of a wet water tube boiler with an ungrounded, portable hand lamp in his hand or hung perhaps around his neck. Industrial commissions and labor boards are beginning to formulate their own regulations in order to do away with hazards which perhaps their existing codes do not adequately cover, and there is a move actually on foot to make employers criminally liable.

In connection with the subject of artificial grounds and methods of measurements. Most codes and grounding requirements provide for the use of artificial grounds and generally specify the resistance of such grounds, but so far as I know that is about the extent of the attention which is given to the matter; in other words, practically no attempts to measure the resistance of the artificial grounds which are installed on their customers' premises. There are two major reasons for this. The necessary measuring equipment has been pretty expensive and generally not of a conveniently portable type and in addition it has been necessary to transport and drive a couple of reference grounds which have to be withdrawn later and transported some more, and then as the measurements are made three ways, it is necessary to employ a formula in order to arrive finally at the resistance of the ground being tested. It is beginning to look as though some of these difficulties at least were being overcome. It is now possible to get a strictly portable meter, weighing only six pounds, very rugged and designed for general knocking around, and which reads directly in ohms, so that the meter end of the problem is fairly well taken care of. The rest of the difficulty we still have with us, but a thought has recently been put forward which I am going to explain to you, because I believe it should be given very careful consideration by everybody interested in this problem. As a general proposition a single ground rod or pipe will not give sufficiently low resistance, therefore necessitating at least two rods. Now if two rods are going to be used at all it is far better to use them in the first place, because smaller rods may be used to advantage, and they may be placed to better advantage. Now if two rods are used the testing problem is greatly simplified, so much so that it can readily be left to any intelligent lineman, because all that it is necessary to do is to measure the resistance of the two rods in series, since the resistance of the two in multiple will never exceed a certain known percentage of the resistance of the two in series. Thus it is quite feasible to give a construction crew definite workable instructions as to the re-

resistance requirements of any ground they may be installing.

Grounds must be of equal resistance, or per cent. will be lower.

Spacing.	Per cent.
6 ft.	31.
7 ft.	29.7
9 ft.	28.6
10 ft.	28.4
13 ft.	27.4
20 ft.	26.4
25 ft.	25.4

From this point the curve flattens out, never dropping below 25 per cent.

For spacing of less than six feet the percentage will vary considerably with the depth of the pipe, and as it is necessary to keep at least six feet apart in order to get a reasonable advantage from the multiple grounds it is not important to consider anything closer than six feet.

So far as installations on the customer's premises are concerned, the contractor can measure his ground when he installs it, and then the inspector can measure it before it is finally connected up in service, or in other words, the rods would be put in and inspected in the same way and at the same time as the rough wiring, the final connections to and between the rods, being made when the job is finished up.

Mr. T. C. James, H.E.P.C. of Ont.:

I think one of the most important features that Mr. Wood has brought out in his paper is the necessity for testing grounds, and also the necessity for making periodical tests It is one thing to instal a ground, and it is another thing to be assured whether that ground is satisfactory or not, and in operating conditions, especially on distribution systems, not only the original test, but periodical tests are absolutely necessary in order to ensure satisfaction. I remember some peculiar instances that happened in the early days when we were installing the 4,000 volt grounded neutral system for the first time. In many of the towns, the construction department would construct the distribution system, and another construction department would construct the substation. The distribution system would be very satisfactorily grounded, with driven grounds and to water pipes, wherever possible, and the substation ground would be very satisfactorily installed. Another department would come along, and would want a service from the station, perhaps a small station, where a two-wire service could be run in. One side would be, of course, grounded. And it was invariably found that there was a considerable difference of potential between the neutral of the service, which was going to the distribution ground and the station ground, showing the absolute necessity of tying the two grounding systems together. I have known lots of cases where trouble has originated in lightning arresters on distribution systems, due to the driven grounds being in unsuitable soil such as gravel. If satisfactory tests had been carried out, that sort of thing would not have happened. I also think it is necessary to get on to the water pipes as much as possible, because with driven grounds the grounding of the system may not be satisfactory.

Mr. W. H. Mulligan, H.E.P.C. of Ont.:

Mr. Wood has informed you there has been a Committee working on grounding in the Commission for the past few months. The results and the deliberations of that Committee are, I think, very well brought forward before you in Mr. Wood's paper. Mr. James stressed the absolute importance of not only grounding in the first place, but, after you have grounded, knowing your ground. There are certain cities in the United States carrying on a geological survey of their cities. They know that, at certain portions of their cities, they get good grounds by only going down a few feet. There are other sections of the city where they have got grounds up to twenty-five, thirty, or forty feet, strips buried in soil as Mr. Wood described. So that is a very important point, gentlemen. As Mr. James said, test your grounds. If you don't know what your grounds are, don't put them in. In looking over some recent accidents during the last few years, the question of inadequate grounding has been driven very firmly home. I will just cite you one case. A young man was working in a substation when a surge came over the line. It spilled over the insulator, jumping to the steel work of the roof, through the reinforcing of the roof to the gutter and down the down-pipe. It passed through an eight-inch brick wall to a groundplate on the opposite side and started down the ground wire to earth. This wire passed near a conduit to which it jumped. The man was in contact with the pipe work, and it went through him to ground, seriously burning him. Now, there is a case of an improper ground on the steel work in stations. The best example of a ground on the steel work in stations that I know of is the Queenston Power House. Every bit of metal in that station is solidly tied together with 0000 copper. The whole floor is embedded with it. Mr. Wood raised the point of placing an operator at the line disconnecting switch at the same potential as he handles. I think that is a very good idea. I am sorry to hear that the distribution department, or the transmission section do not agree with that and would rather build a platform. Platforms are all right, gentlemen, if you get them in. But our great trouble is to get the platform in. There generally isn't a place in the street to put them in, and then there also has to be a man following them up. Again, there is the question of voltage. 150 volts, to my mind, is too high. There is not one of you gentlemen can make a hand-to-hand contact, a perfect contact, with anything above 14 volts. Mr. Borden, I think it was, raised the question of the ground to portable tools. There is a Committee working through the National Safety Council at the present time on the question of the grounding of portable tools. I quite agree with him that it is an absolute crime to send a man into a boiler with some of the portable cords that we find throughout the Province of Ontario. There are a number of Power Houses at various places where, below the Power House floor level, they have no voltages above fourteen volts, because the men working down in that section are

working in places where, when they make contacts, a contact may be fatal. I think myself the proper solution, in connection with portable tools, will be that, if you cannot properly ground, you will have to reduce the voltage on portable tools to a safe voltage.

Mr. J. H. Caster, H.E.P.C. of Ont :

The grounding problem is a big one. As Mr. James said, the most important thing is to finally get some method of testing, and I would like to know more about the Wheatstone Bridge method, and I would like to have an example of it so that everybody here could find out how to use it. There is a question I want to ask, and that is in connection with grounding individual surfaces. Some years ago, it apparently was in our rules that it was compulsory for each individual service to be grounded in all municipalities and, I expect, in all rural districts. At the present time, I do not think that is the case, and I am wondering why. We do not ground our services in towns or villages unless we think about it, and it is all right if we don't, I understand, and certainly, in the rural districts, we have not been doing much of it. Now, we all know our rural districts are poor. We have got to cut down expenses, as far as we can, for them. The reason we possibly have cut down our grounding to a certain extent, is because we are unable to get on to a water pipe out in the country. I think it should be compulsory to have each individual service on the rural, as well as urban, grounded as well as we can get it. I would like the inspection department to correct me if I am wrong in this ; but if I am correct, give me some reason why we are not insisting on individual grounds.

Mr. C. W. House, Inspection Department, H.E.P.C. of Ont.:

In the rural districts, the service pipe itself is grounded to a driven ground, but not the individual service ; but in cities, where we can get on water pipes, or in towns where we can get on water pipes, the individual service is well grounded to the water pipe. In rural districts, if we cannot get to water pipes, just the conduit itself, and not the current carrying parts are grounded.

Mr. J. E. B. Phelps, Sarnia :

I had an accident in Sarnia last week, by which we lost a man. Our linemen worked over this man for about five hours before we had to give up, and the doctor pronounced the man dead. Now, this man was caught between a 2200 volt primary, and the street lighting line. So the question that arises in my mind is this : Why should our series lighting circuits be grounded during the day time, or why are they grounded ? Is it the value of protecting some equipment is more important than a man's life, or what is the idea of having it grounded ? This is how the man was killed. He made a contact in making a joint, just above his glove, and apparently he either slipped or he was standing with his left ankle up against the insulator of the street lighting circuit. There is no doubt in my mind the man was dead before we got him off the pole, although, as I say, we worked over him for five hours trying to resuscitate him, because a month previous there was a man got an electric shock on the rural system, and, with the

help of the rural men and some of the St. Clair Transformer operators and some of the Sarnia Hydro operators, we worked over that man for eight hours, and, as you know, we were successful in bringing him around. So that is the point raised in my mind ; and I would like to know just what lines we should ground, as well as the value of the ground.

Mr. Caster :

I would like to answer Mr. Phelps; where, unfortunately, he had a man killed, which he claims was caused by the grounding of the street lighting wire. We have previously had men killed for the reason that street lighting wire was ungrounded. For instance, a series street lighting circuit is known to be dead in the day-time. If, by any misfortune, a 2200 volt line comes in contact with that street lighting circuit and a man touches it, he is killed just the same. That has occurred more frequently, I think, than the condition Mr. Phelps speaks of, where the man made contact between a 2200 volt line and the street lighting circuit supposedly dead or grounded. Now, Mr. Phelps is just doubtful whether that man would have been killed had the street lighting circuit not been grounded. It certainly is not to protect the apparatus that we ground that street lighting circuit. It is to protect the man from getting in contact with the line that he knows is dead, and which kills him due to a voltage occurring between that street lighting circuit and the line.

Mr. James :

Another reason why series street lighting should be grounded during the day-time is due to the inductance. We had an actual case where a series street lighting system and 22,000 volt wires were several feet above it—perhaps twelve or fifteen feet—and yet, there was enough inductance on those lines to seriously shake a man up. It is also a necessity for grounding the street lighting circuit.

Mr. Mulligan :

Both Mr. James and Mr. Caster, I think, have told Mr. Phelps why the necessity of grounding series circuit. You will notice the recommendation in Mr. Wood's paper is that the ground lead on the pole should be covered to prevent injury to the lineman when climbing the pole in case he comes in contact with a wire handling current and the ground at the same time. The standard recommendation is that a ground wire up the pole to the cross arm, and on the arm be covered. That is so that a man working on the pole will not be up against the ground, if he is working on a pole on which there are live circuits, and at the same time exposed to the ground circuits. The ground circuits should also be covered with protective devices, as well as any other live circuits on the pole with which the man may come in contact. That is the only answer I can give to prevent an accident such as Mr. Phelps had. Cover up everything that is not in use which your man will come in contact with. That is, if it is necessary to work on the pole with the circuits alive. Mr. Phelps, could that have been done in Sarnia, in this case ?

Mr. Phelps :

Oh, yes ; it could have been covered.

Mr. Mulligan :

That is the point, gentlemen, to remember. If you are working on a pole on which there is series circuit, if the series circuit is grounded, pay as much attention to it as you do to the transformer case, or any unguarded ground wire on the pole, or any other ground material.

Mr. E. V. Buchanan, London :

With reference to that last point, I believe that all circuits should be regarded as ground circuits. As a matter of fact, your primaries are usually grounded, and your secondaries are grounded, and I think that the street lighting circuits should be regarded as grounded circuits also, and therefore a man should not take any chances in coming in contact with any other circuit. There is another point I would like to make. In Waterworks Departments, the use of water meters are becoming more common. The Waterworks men are under a certain amount of hazard in changing these water meters, because, usually, the house grounds are made on the house side of the water meter. Immediately they remove the water meter, they open the ground circuit. We have arranged now that every water meter is jumped by a piece of wire on two ground clamps, so that, when the meter is removed for testing or other purposes, the ground circuit is not disturbed.

Mr. R. H. Starr, Orillia :

We have taken care to protect the transformer cases by grounding, and which, in my idea, forms a great hazard to men working on the pole. Personally, I do not favour grounding the cases on that account, until they get out some sort of insulated cover to go over the case. Has the Committee also considered the question of whether salt added to the ground has had any beneficial effect, or whether the adding of salt counterbalances the increasing effect of corrosion on the ground plate ?

Mr. Wood :

With reference to Mr. S. W. Borden's contribution, I might repeat what was stated in my preliminary remarks, though not printed in the paper, that there was no particular attempt made to give complete specifications as to methods or to make a complete list of items which should be grounded.

This explains why certain items which Mr. Borden naturally expected to find covered by the paper were omitted. His contribution to the discussion is therefore particularly valuable.

With regard to size of ground lead, the necessary requirement is that it should not burn open. The tendency to fuse is a function of the available current and the time which it is allowed to flow, which are limited by one or more of the following :

(a) By limitation of the amount of current in the ground lead which can be produced by the connected system. This value can usually be calculated with sufficient accuracy.

(b) The current capacity of the power lead.

(c) The current-time characteristics of fuses or circuit breaker trips (relays).

The latter is usually much the lower limit and if clearance by this means is dependable, advantage may

probably be taken of it to keep down the size of the ground lead.

With regard to grounding of services we recommend that the secondary neutral be grounded at each transformer pole and at each service.

The point was raised in several ways whether unused circuits, transformer cases and other non-current carrying metal parts on a pole should be grounded. I would apply the rule which was laid down in the paper, that if the part is liable to become alive by misplacement or by insulation breakdown, and without giving warning to the lineman, it should be grounded, otherwise it need not be. In any case a fixed practice should be followed so that the lineman will know whether the object is grounded or not. If it is grounded it should be treated as ground, and if it is not grounded, it should be treated as alive and shielded like a live conductor. A possible exception is pole hardware when it is well clear of grounded or live objects so that the lineman can see that it is isolated from both. This might be left ungrounded.

Replying to Mr. Starr's last question, our inspectors have not found much tendency to corrode due to salting, although there is undoubtedly some. Corrosion is worst at the junction of dissimilar metals when subjected to salt solutions. Copper sulphate solution is stated to be less corrosive than common salt.

Flood Lighting of the Administration Building

The floodlighting of buildings is becoming recognized as an essential part in the decoration of buildings for celebrations and special occasions as well as for permanent illumination for advertising and sentimental reasons.

The Administration building of the Commission, along with many others, was illuminated for the Confederation celebration, and a brief description of the temporary installation may be of interest.

It is generally desirable when planning the lighting of a building exterior to have the general direction of the light correspond to the direction of daylight, that is, from above, so that the shadows will appear as the architect intended them to. However, in this case there is no place available from which to direct light from above, and the best use was made of the situation as it was. The lighting of the main facade above the first floor was accomplished by thirteen projectors, each with a 1000 watt lamp and one with 500 watt lamp mounted on the top of the entrance porch and concealed behind the ornamental front. The light projections from the fourteen units were spread fan-fashion over the front up to the cornice above the fifth floor. On each side of the entrance steps is a ledge upon which were placed two projectors, one on each side with a 500 watt lamp to light the front of the first floor and one on each side with a 1000 watt lamp to light up the decoration on the entrance porch. Arrangements were made with the

decorator beforehand to conceal these four projectors by the decoration.

Owing to the very short distance from the projectors to the front of the building, from 5 to 7 feet for those on top of the porch, it was necessary to place broadly-diffusing cover glasses on the projectors. The type of glass was selected by trials at the laboratory.

The power, 16,500 watts, was supplied by a 220-110 volt, 3-wire circuit controlled by a time switch.

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in June, 1927.

Appliances

AUTOMATIC ELECTRIC WASHER CO. INC., Newton, Iowa.

Portable, motor - driven, electric washing machine. Model 20.

* * * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, 224 Wallace Ave. Toronto, Ont.

"Hotpoint" Curling Irons, No. Cat. L.11.

" Upright Toaster, Cat. No. T. 13.

" Soldering Iron, Cat. No. L.21.

" Domestic Iron, Cat. No. F.22.

* * * *

HAPPY HOME MANUFACTURING CO. LIMITED, 12 St. Clarens Avenue, Toronto, Ont.

Portable, motor-driven, washing machine.

* * * *

CHARLES JOYNER & CO., LIMITED, Icknield Square, Birmingham, Eng.

Electric Air Heaters.

"Angelus Coalfly," one-bar type, Cat. Nos. 3900 and 3902 ; two-bar type, Cat. Nos. 3910 and 3912.

"Angelus," two-bar type, Cat. Nos. 3776, 3777, 3780, 3781, 3782 3783, 3786, 3787, 3788, 3789, 3820, 3821, 3512, 3513, 3515, 3516, 3518, 3519, 3521, 3522, 3826, 3827, 3800, 3801, 3802, 3803, 3806, 3807, 3808, 3809.

Three-bar type, Cat. Nos. 3778, 3779, 3790, 3791, 3792, 3793, 3796, 3797, 3798, 3799, 3527, 2528, 3530, 3531, 3533, 3534, 3498, 3499, 3810, 3811, 3812, 3813, 3814, 3815, 3818, 3819, 3742, 3743, 3745, 3746, 3748, 3749.

"Gothyn-Angelus," three - bar type, Cat. Nos. 3540, 3541, 3543, 3544.

* * * *

THE NATIONAL ELECTRIC HEATING CO., LIMITED, 544 Queen St. E., Toronto, Ont.

Immersion type water heaters, Cat. Nos. 870, 875, 880, 870B, 875B, 880B.

* * * *

ROYAL ELECTRIC HEATER SALES CO., 608 Park St. West, Windsor, Ont.

Circulation type water heater.

* * * *

UNITED RADIO DEVICES, Oshawa, Ont.

Radio "B" current supply unit.

* * * *

HARRINGTON CO., THE, 17th and Callowhill Sts., Philadelphia, Pa.

Electric hoist, Model E.

* * * *

Switches

ABSOLUTE CON-TAC-TOR CORPORATION, Elkhart, Indiana.

Temperature Regulating Appliances.

Timed Switch, Cat. Nos. 111A-111F inc.

Stack Switch, Cat. No. 480.

* * * *

*COLE METAL PRODUCTS CO., Inc., 33 Crescent St., Long Island City, N.Y.

Enclosed Branch circuit cutouts, Cat. Nos. FP-4, FP-6.

* * * *

*HART & HEGEMAN MFG. CO., THE, 342 Capital Avenue, Hartford, Conn.

Fixture Switches :

"H & H." single-pole, Cat. Nos. 20510, 20590, 20595, 20599, 20957, 20983, 20991-94 incl., 21064, 1058, 1079, 8000, 8111, 8201, 8327, 8510, 20039, 20121, 20155, 20189, 20192, 20253, 20270, 20299, 20397 20429, 20513, 20552, 21113, 21142, 8700, 8700A, 8849-50, 20573, 20940, 20955, 20978-79, 21106.

Double-pole, Cat. No. 20388.

* * * *

*HEINEMANN ELECTRIC CO., 1730-36 N. Fifth St., Philadelphia, Pa.

Plug Fuse Cutout Bases, Cat. Nos. 1935, 2135, 2165, 2199, 2199-0, 2587, 2587-0, 2965, 3082, 3082-0, 3084, 3084-0, 3085 3085-0, 3095, 3115, 3215, 8042, 60, 63, 3086, 3086-0, 3087-0, 3315, 3415.

Marking : "G.H.Co." or "H.E. Co."

* * * *

Fittings

JOHN A. DYNES, Hamilton, Ont.

Metal fittings for show window lighting.

* * * *

WILSON ILLUMINATION CO., LTD., 83 York Street, Toronto, Ont.

Metal fittings for show window lighting.

* * *

*CIRCLE F. MFG. CO., Trenton, N.J.

Medium Base Sockets (as listed on Underwriters' Laboratories card dated May 13, 1927).

* * * *

*WALKER BROS. (Mfr.), 937 N. Front St., Philadelphia, Pa.

Walker Brothers (Submittor), 12 E. 41 St., New York, N.Y.

Raceway—Underfloor.

Cast - iron junction boxes with covers, Cat. Nos. 80, 86, 200, 240, 250, 290, 294, 295, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400.

Outlet fittings, Cat. Nos. 128, 221-1, 221-2, 228, 1270, 1272, 1274.

Miscellaneous fittings, covers, adapters, elbows, dead end fittings.

Marking : Manufacturers' name, initials, or trade mark "Alsteel."

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.—*Editor*

THE
BULLETIN

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Research and Service

By Dr. Oskar Klotz, Professor of Pathology and Bactieriology, University of Toronto

(Address before Ontario Municipal Electrical Association and Association of Municipal Electrical Utilities at Niagara Falls, Ont., June 23, 1927)

WHEN I discussed the matter of meeting with your Convention and discussing some problems with you, it seemed to me it was a very distant thing for a Professor of Pathology to come and meet with your Convention, where your problems are so distant, where your thoughts are involved in things that are very far from the thought of my own mind, and then it dawned upon me that perhaps we had something in common, and I said "Yes." We have. You and I both have a mission in life : service. We often think, "What is this Professor of Pathology" ? meaning what is he doing ; what are his interests ? I will try to indicate to you that it is an interest very similar to yours, based upon service.

Our grandfathers came to this country, hewing their way through the forest. Some came in the covered wagon ; some in the old conestoga ; some came on foot ; some did not even have their implements or their horses or cattle with them ; but they hewed the way through that forest. They hewed out the plantations ; and we see the result to-day. You and I are living in comfort. We have opportunities that they did not have. They had energy and enthusiasm, and they came to a country that they knew was a democracy in its true light. They were doing it for the love of it, and not for return. Neither your grandparents, nor mine, were getting the comforts out of life that we think of. Then we think of the present and what has happened. We are lightening the burden for all the people of Ontario. Each of you is

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participating in and helping the people far and near to be able to accomplish those things which, previously, were a burden.

It is said to-day that, in the last seventy-five years, we have increased the span of life eleven years. It has often been stated that it is entirely through the activities of the medical profession and their researches. True, much has been accomplished there, but that increase in the span of life of eleven years has been able to be accomplished because you and I have been assisting all of the community to carry their burden just a little easier. We are no longer living under those conditions of the middle ages where old age came at thirty ; and there are still many of the districts in Europe where old age to-day is still at thirty. It is because of the accomplishments of the united service of individuals to others.

That great man Edward Trudo went into the medical profession, but had hardly started when he was smitten with tuberculosis. He had a vision, however, a viewpoint of the future ; and he had energy and enthusiasm. He secluded himself for awhile, taking care of his health as best he knew, and this is some fifty years ago, going into the hills in the State of New York, into the Adirondacks. He found that a certain mode of life, a certain care of himself, improved his condition materially ; and when he had accomplished that, he said to himself, "Why cannot I do this for others ?" Edward Trudo is the man who started the whole system of sanitaria, not only in the United States, but the world over. Towards the end of his days, Edward Trudo made the statement that the highest mission in life for any man is to serve his fellow-beings. Now, it does not make any difference what you are doing, it does not make any difference what your activities are, whether you are engaged in professional electrical engineering, whether you are engaged in the administrative work of the municipalities, whether you are engaged on Commissions, or whether you are engaged in distribution, each and every one of you are assisting other men. Your mission in life is that which Edward Trudo indicated is one of our highest ideals.

I am also brought to a comparison of your work with some of the things that we are meeting with in medicine. In studying the human body, we have become very much impressed that there are certain structures in the human body which are very small, but they are important. No doubt many of you have read in the news-

papers the importance of certain glandular structures which have been exploited by certain French physicians for the rejuvenation of youth. There is a certain amount of truth in it. There are certain structures in the body that are absolutely essential for the lubrication of our living tissues, that are perfectly essential and necessary ; and, if wanting, the mechanism no longer functions properly. I am reminded very much of this little glandular structure you have built on the Niagara River, hidden away in the rocks, tucked away in a little niche, inconspicuous unless your attention is drawn to it, which is a very essential structure in our community, from which there radiates a system which rejuvenates throughout our Province, the municipalities, and gives them their very life, light, heat and power, one of the great essentials for the maintenance of human progress. Light, heat and power are the characteristics of these little glandular structures in the body. Light, the burning enthusiasm of the individual, is dependent upon them. Heat, the combustion of structures within our body, maintained and balanced by these minor glandular structures. Power, our energy is controlled by means of these small glandular bodies. Our progress today, the progress of any industry, is dependent upon research; and I refer to the individuals who possess that energy of mind to delve into the problems of nature, to try to ferret out the forces that are hidden there, from which we gain our own energies and from which we are able to accomplish our object.

The last hundred years stand out prominently, and those advances that have been made live only through the intensive interest, the researches, the advances that have been made by men devoting their lives to a search for the fundamentals of nature. Our best accomplishments are made by the searchers for the fundamentals. Sometimes we have difficulties in perhaps realizing that to its fullest extent. We may have a problem in connection with our Hydro, that we have a certain wastage, let us say, of ten to twelve per cent. in transmission. The Hydro may say, "We would like to solve this and save another five per cent." Is that saving of another five per cent. to be accomplished by putting that problem as such before any group of individuals ? No. But it will be accomplished when we know more why wastage takes place. Only when we realize the why's and the wherefore's, the very root of the matter, can we hand over the problem on its practical side to the technical men to work it out. But we must know its fundamentals. Our best accomplishments have been made by those men who have started just in a small way ; just like your Hydro Commission. Twenty-two years ago, when it started, it started in a small way. It found its footing. It developed. It is developing. And it will continue just as long as we put our energies behind it, seeking out our difficulties, solving our innermost problems, and taking advantage of those fundamental principles that will be laid bare to us. Think of men like Lord Kelvin (Sir William Thomson). William Thomson was unknown,

but starting in a small way, made that tremendous development, upon which so much of our present-day knowledge of physics and its applications, not only in electricity, but also in hydro-statics and so on, are founded, working in a cellar where he had to knock down the beams to make room, and put in a little sink to have his running water. There was the mind behind it with a vision. There was a man who was seeking to solve some of the riddles of nature. Again, Pasteur, who revolutionized our whole idea regarding the health of the people. Pasteur was the son of a tanner, with little education. He specialized in his technical schooling in chemistry, and then certain problems were called to his attention. He wondered why curious changes took place in the big tanning vats. He wondered why wine became sour. France was largely dependent upon its wine industry for its export, and it lost, every now and again, a large portion of its vintage because it went sour. Later on the silk industry had a very bad year. The silk worms died before they had accomplished their work. Here was this individual with a chemical training, but, nevertheless, with a receptive mind, anxious to solve some of the secrets of nature. That man applied himself, first with a chemical mind, seeing that certain curious changes took place in wine when it underwent fermentation and became vinegar, certain new substances were developed, that, on the ordinary principles of chemistry, could not be explained. Then he studied it further, and found a peculiar mould. To make a long story short, he discovered that the living micro-organism growing needed certain substances for its own life cycle, and in utilizing them brought about this curious conversion. The man that started in a small hut, grew to tremendous proportions, and before he died, brought about the revolution of our ideas of disease in the human being.

We have that Englishman, Joseph Lister, the man who immediately realized, in Pasteur's finding, the direct application to surgery; and instead of surgery being a thing to be feared, it then became an operation which could be undertaken with impunity. He found that micro-organisms, differing, it is true, in very small and essential characters from those that Pasteur found in wine, were the reason why surgery was to be abhorred before he found and applied the Pasteur idea to this subject. Lister also started in a small way. An unknown man up to the time that he indicated that he had a viewpoint and a vision. Is there any higher service that we can offer than service to our fellowmen?

I mentioned a moment ago the importance of research to industry, and it is only recently that an eminent Professor in Chemistry, who has become interested in many commercial works, made the statement that, before investing your money into any industry, make certain that that industry is alive to the value of research to its work. If it is not, it is at a standstill, and in a short time it will be on the toboggan. There is no greater truth. To only manufacture the same thing over and over again, it will be defeated soon by the other man who does it one thing better.

Either he is going to make a saving in the manner of production, or he is going to make an improvement in the character of the output. In the end, the man who uses research and continually uses it in his industry is going to be the man who is going to advance.

You may say, "I will give you examples in which research had nothing to do with the success of an individual." I will grant you that. You tell me that Cobalt was not discovered by research. I will grant you a blacksmith's hammer was hurled at a fox and knocked a piece of rock from a ledge, and, lo and behold, there was silver. Research was not necessary. But did that man develop Cobalt? No. Did our community reap the harvest of Cobalt, because of that sledge hammer? No. It had a certain personal gain, temporary in character, short-lived, but the work that has been done in Cobalt has been done by the men who put thought into it, who have studied the problem, who have put the best interests at stake, who have compared it with the character of mining in other parts of the world, and who have modified those methods to apply to Cobalt, and those mines did not go on the toboggan nor were they bought up by the others.

In Timmins and through that region, we have a very curious rock that contains its sulphur, its gold, a certain amount of cobalt here and there, and copper in regions, in paying quantities. We are mining it as rapidly as we can to gain results, forgetful of our surroundings, when an officer comes in and says, "Here, we want compensation from you; you are injuring the miners. Your miners are suffering in health. You cannot go on in this fashion." We have a problem there very similar to that of South Africa, where, in the big mines they have a rather curious condition develop amongst the miners in relation to the mining of quartz, inhaling dusts, and getting a curious dust disease. The mining companies have suddenly come to realize that they have a problem. How is the problem to be solved? We cannot stop mining. We must go on. But we must find a way of prevention, and that way of prevention to-day is one purely of research. We are not yet in a position to say exactly what the solution may be, but here again there is going to be a community interest. It is an interest to the State, to the Province, and to the mining company, an interest to the miner and to the community because of the compensation which must be returned to those who are injured.

This world to-day is very gracious to its fellowman. It is not charity. But we realize to-day that we bear an obligation to him who is injured. We bear a definite responsibility for his care. We have taken care of the tuberculous; we have taken care of those who have become incapacitated; we have taken care of those who have suffered certain physical disabilities. That is one of our obligations; and as I say to-day, our communities are very generous. But we do not wish to accept the burden unnecessarily if it can be prevented. Prevention is one of the most important things, insofar as the health of the people is concerned, rather than cure. Speaking generally, from this

stand of prevention, from the attitude which the community takes to the ills of others, we are no longer in that position that we can be negligent of what goes on in our neighbouring communities. Not only is it an obligation, but it is a protection to ourselves. I have had opportunity, on a number of occasions, to serve on Commissions of that kind. On one, I have spent three years in Brazil in connection with the Rockefeller Foundation, and last year I spent in West Africa for the same organization. There is often a wondering, sometimes a misunderstanding, of this Rockefeller Foundation. It is a large benificence that was granted by Mr. Rockefeller, a community service which has been dedicated to all peoples to improve health. And so great an impression has been created of what can be accomplished by an organization that the largest work to-day that is being undertaken by the League of Nations lies in the protection of health. The largest work that the League of Nations is doing in the line of the protection of health is sanitation. Now the Rockefeller Foundation is interested in a variety of problems the world over. You would be interested to learn of the innumerable places on the world's surface where they have their agencies for the doing of good, laying the line of health. These agencies by no means encroach upon the local status of health agencies or the administrative work in the various countries or colonies they are working in. I can indicate that more particularly in the last relation that I had with them in West Africa, where we were in British Colonies, Nigeria, and the Gold Coast. Here we worked in direct co-operation with the British Government. Our problem was yellow fever.

Now, the reason for going to Africa. You might say, "Charity begins at home." There are certain diseases which can be controlled, and should be controlled, so as to prevent their spread, to protect commerce, and to make certain countries liveable. The tropics, to your mind, no doubt, recall the picture of romance, of profiteers, of the Spanish invaders, the aborigines, and of Capt. Cook. But the tropics to-day is a different picture entirely. We have got to go to the tropics for certain materials. The tropics have been left alone for many years. We did not need them. We did not have any interests there. We got our spices, it is true, and odds and ends for the rich man's table ; but to-day the tropics demand an entirely different interest. Our neighbour to the south of us, up until quite recently, was able to feed the mouths of the people living there, was able to supply the grain, the meat, the foodstuffs, the fats, and so on that are essential to life. To-day they can no longer do it. The United States is no longer an exporter of grain. They are an importer of grain. They are no longer able to supply the oils and fats that are necessary in their footstuffs, and they have got to go outside. They are beginning to utilize more and more, imported rice, and they are very desirous of having more vegetable oils. They have the cottonseed oil and so on, but it does not suffice, and much of it is not of good quality. Curiously, the tropics supply an unusual quantity of oils that are very

useful, and can be manufactured for human consumption. In South America, the Valley of the Amazon is just as much a desert, a jungle desert, as it was ten years ago, and more so than it was twenty-five years ago ; because twenty-five years ago the Valley of the Amazon was producing a lot of rubber. The jungle has grown over the old plantations, and, as far as human habitation is concerned, it is a jungle desert. Africa is not very inviting, has always had an evil reputation, the white man's grave ; and there is a certain amount of truth in it. It is not the climate that ever killed a man there, but the curious diseases, and it is not a white man's country. Now, if we are going to have any use of the tropics, we have got to make it safe, not necessarily for democracy, but certainly for life. Now, it is interesting, too, that all of our tropical diseases are so different from those here. The thing that keeps a man out of the tropics is the insects, not that the insects themselves drive them out, but they are the conveyors of disease. If we could control the insects in the tropics, it would be just as healthy living as it is in our temperate zone. The insects are conveyors of disease and the destroyers of the plantations ; the insects are destroyers of your home. You cannot build a house there unless you build it entirely of cement. The ants and the mice chew tin and wood; and it will tumble on your head. You cannot sit down in the tropics on the ground, as you do in the woods here, on a pleasant afternoon ; the insects would drive you out. You cannot sit around outside in the evening for the mosquitoes and various forms of flies —not that you mind them any more than you do here—but they are a menace to you because they are the conveyors of disease. Now, you will realize that when an organization like the Rockefeller Foundation, undertakes investigations in far-distant lands, researches to find out the underlying why and wherefore of conditions that exist there, you will realize that there is a very good purpose. It is a very distant vision to give an opportunity for the white man to undertake further development of these enormous stretches of land, to develop the things that we need, the things that are essential to us, if we are going to maintain the advancing population as rapidly as it has been growing the last hundred years.

The policy of Great Britain, in her colonies in these distant lands, is very interesting. There has never been a greater democracy than that founded by Britain ; there has never been a democracy that has had such an ideal breadth of view as that of Britain. These colonies in West Africa are inhabited entirely by the Blacks, not only a good race, but numerous tribes. Very many tribes are in Nigeria, a number more in the Gold Coast, tribes that are entirely different from each other ; racial characteristics distinguish them ; languages, in which one tribe cannot understand the language of its neighbour ; it seems a hopeless confusion. Great Britain has dominion over these colonies. One would interpret that, perhaps, at first sight, as meaning that she takes them under control, lays down her laws and regulates the general custom of the people. It is

not the case whatever. The one feature in which she lays down the law is to prevent tribal warfare. That has been done away with. Now, even though no force is used, these various tribes have very definite boundaries to their districts ; they have their own administration, they have their own kings, or, it may be, their own chiefs. So that through Nigeria there are many kings in various provinces, or many chiefs. These chiefs carry out the law as they see it, according to the custom of the people. They are allowed to impose sentences to about £20. That is all—a fine. They cannot inflict the death penalty. They can incarcerate an individual who does not abide by the tribal law and put him in prison, but they cannot inflict the death penalty, so a Magistrate, a British Magistrate, or a Judge, makes a circuit so many times in a year to these various provinces and looks over the justice that has been doled out by the various chiefs, and tries those cases which the chiefs are not allowed to handle. Now, when that British Judge does try a case, he does not impose the British law, but, being familiar with the customs of the people, knowing their tradition, and their general viewpoints, he is lenient to that viewpoint and tribal custom takes precedence over statutory law. Those colonies cannot be exploited. You cannot gain a concession of an indefinite character so as to control either industry or agriculture. But Britain desires to bring up those colonies that they should develop their own agriculture. She is putting junior as well as technical schools in their midst, to see whether she cannot raise them to a level higher than that existing to-day, that they may the better perform their function, not amongst themselves, but participate in the general civilization, in which Britain plays such a large part. In other words, she is trying to educate the child so that it will grow to manhood and be able to be self-sustaining. You have never heard of any other country doing as much for a people, an aborigine people, in which many would say, "It is a hopeless task." Nevertheless she has undertaken it, and she is going to see it through.

Now, Britain, furthermore, gave the greatest of assistance to these researches that were being undertaken in her provinces, on yellow fever, which will subsequently be extended to some other diseases, to attempt to make that tribal district inhabitable. I would like to recount one example of the service that is being offered by men who are sympathizing, who are dedicating their lives to service. When I was in Nigeria, in the upper province, I ran into two men of whom I had heard before, who were living in the middle zone of Nigeria, just on the outskirts of the jungle. These two men are living 180 miles removed from the nearest community, and in that nearest community there are only one or two whites, the administrative officer and his assistant. These two men, by the names of Lloyd and Johnson, are attacking the problem of sleeping sickness, one of the scourges in Africa. Central Africa, particularly the Congo, is infested, and for a time we had hoped that it was located in the Congo alone and not to be found outside of this zone.

We were disappointed in that, however, and sleeping sickness has spread, is still spreading, has entered the upper portion of Nigeria, and is threatening to decimate a considerable portion of this country. Sleeping sickness attacks the black man very severely, and attacks the white man too. It is conveyed entirely by a type of fly that is peculiar ; you find it along the river banks, or along the little ponds. The fly breeds in shady places, not in the depth of jungles, but rather in the shady shores. These two individuals devoted their lives in studying that fly. They learned all about it : they learned all its habits, its food, its breeding places, how the breeding took place, the development of the little larvæ, and how long it took for this larvæ to mature before the new fly was developed. They were then able to go back to the British Government and make a proposition. "Let us destroy the breeding places. We know where they are. Not that we know the spots, but we know the characteristics of the breeding places. You do not need to go into the centre of the jungle, and you do not need to go out on the plain, but it requires damp soil on the edge of waterways, and it requires shade. Give us an opportunity to destroy the breeding places and see whether we cannot stop the spread of sleeping sickness in Nigeria." Lloyd and Johnson have been living in that part of Nigeria for a number of years, isolated, no contacts with the white, none of the comforts of home, very little as far as food. They live mainly by their rifle. You never saw a happier pair, working away at these studies. They have now been given an opportunity of trying out their proposition. They have cut a wide swath through one portion of Nigeria—that was, ten years ago, when I was there—and sleeping sickness did not cross that swath. It varied from a mile to a mile and a half in breadth. They hired great hordes of natives to do the cutting, and is wider than the fly will migrate or fly across. The fly will not breed in a stony place. We need not fear that it will get across to breed in the intermediate steps. They have probably solved the problem. They studied the very depth of their problem, all the characteristics, all the ancillary relationships. They have been able to offer a proposition that seems to be a solution for the spread of sleeping sickness. It means a lot of work, it is true, but that is the only manner in which we can accomplish something for the natives there, for it is quite impossible to attempt a method either of control or of teaching sanitation to those people at the present time, in their present pagan ignorance. Those people are very amenable, and I feel very lenient, very patient with them. I believe the spirit of the British Government is the right one to take ; I believe that we can do much, and with those people who can find a little niche in the workings or the development of our further civilization.

We have been speaking about research and the value of doing a thing one step better than it was done before. We have realized that, in the last few years, in Canada, and our Federal Government is giving support to what is known as The National Research Council. The Na-

tional Research Council is for the purpose of delving into and assisting in solutions of national importance. It studies a variety of problems. The problems may be in re-forestation of lands, in geology, mining, may be again, in the fevers, as they have a number of problems before them. Again, the problems may be with the animal industry. This incident comes to mind. The Breeders' Association not so long ago, approached the Federal Government with a complaint that they did not believe the imposing of a regulation for the institution of the accredited herd system in Canada was right. By an accredited herd system they mean that the Government gives a registration for a good herd, that it is scot free of disease and particularly tuberculosis. Tuberculosis, you know, is very common in cattle. They believed that this means of regulation governing the accredited herd system was hardly just to them, inasmuch as they were losing too heavily by attempting an accredited herd system, because if any one or more of their animals are found to be infected with tuberculosis, those animals must be slaughtered, so that often a breeder will lose very valuable stock. Very often you will find that that animal is not severely affected with tuberculosis

The Government is interested in the problems of every individual that have a national bearing. They wish to study it, and they will give the means for carrying on these investigations. The Government has put aside a certain amount of money that has been relatively adequate up to the present time and are spending in a year a sum upwards of $250,000.00. The men offer their services free, the Government simply paying the charges of the materials and the expenses that are necessary in carrying out the investigations. This is a very valuable means of inducing research into the various important industries in the country. The industries themselves are becoming alive to its importance. It is not, however, the industries themselves so much who are applying for assistance from the National Research Council. We are finding that they are applying research into their own organizations. It is true, of course, that every industry cannot afford to put in a technical staff to carry out researches, but the means are available to-day for them to have those researches carried out. In the larger industries it is advisable, of course, that they should have those means readily at hand, and available in their own concern.

A solution of that problem was given by a Canadian—dead since, unfortunately — Robert Kennedy Duncan, of Brantford, who went to the United States, a Professor in Chemistry. He was in the Southern States for awhile, and subsequently came to Pittsburg. He made the proposition at the University. He stated at the University, "Here you have an aggregate of selected men, selected minds, men trained in their particular professions, in their peculiar specialities. You are utilizing them merely for the training of students for education. Why do not those men give a hand to industry? Why are they not available to put into practice what they expound in theory?" He got a hearing from two men who had the

means to be able to try it out. One is now Secretary of the Treasury of the United States, Mr. Andrew Mellon, and the other his brother, R. B. Mellon. They backed Robert Kennedy Duncan to establish an institution to which industry could come with its problems : it did not make any difference what its problem was. There would be at that institution a group of men representing the various fields of industry, or the various fields of science, before whom the problem would be placed for consideration, and they would then mull it over and decide how that problem could be approached, whom they could get to work on the problem, and then refer it back to the industry, telling them about what it would cost to put it over, promising them nothing further as to the result, because that is impossible for any individual. That is, in research you cannot promise results. You can do your best at that, but nothing more. That was organized. It is now known as the Mellon Institute.

They have a great number of problems coming up there, problems of the most divergent kind. I recollect one of the early problems that was brought up when the bakers wanted their bread to be done half an hour earlier than by their ordinary process, because they could save a lot of money with that half hour regarding their shifts and equipment. Well, that seemed a pretty curious problem to attack, to bake that bread half an hour quicker than their machines' process, that they then had instituted. Nevertheless it was taken up, and their whole process of baking, which had been developed to a high grade of efficiency, had to be attacked at its very root, the beginning of the making of bread. One of the periods of time in which a considerable amount of time was wasted or expended, was in allowing the bread to rise. Could they make that bread rise just a little faster ? That required a study of biology, a bacterial study of yeast. Why does yeast carry on its particular work and ferment sugar to produce bubbles in it ? Can we make it do it a little faster? Like all forms of animal life, the speed of its activity lies in the energy available behind it, and, just like those little glands I was referring to that really give the pep to man, there are certain chemicals that give the pep and increase the velocity of action of yeast. The problem was put in the hands of two individuals. Those two men succeeded, and it was a tremendous success for that company to be able to save that half-hour in the process of baking.

Then another problem came along about the same time. When he founded the Standard Oil Company, Mr. Rockefeller did not think of gasoline ; he thought in terms of coal oil, kerosene, because that seemed to be the large sales part of the crude oil. The gasoline was poured into the Ohio River at that time as waste product. Then, the gas engine was brought in and gasoline is desired now. The oil companies desired more gasoline. If they could get one-half per cent. higher production in gasoline from their crude oil, they immediately have a tremendous increase in their revenues and their dividends. They wanted to know whether they could produce more

gasoline. Ordinarily you simply distil it off and get whatever you can, benzine, coal oil distillate, and so on, but can you change some of these into the other. The trick is to do it. Now, there was a problem that was put before a group in the Mellon Institute, and they devised a new method for the so-called cracking of the oil, the changing of one type of hydro-carbon into another. They likewise succeeded, and were able to benefit this particular product. Now there are innumerable problems of the same kind.

That is the type of service, by bringing together the minds that can work upon particular problems for which they are particularly adapted. We are only awakening to the possibilities. In the present development of our civilization, if we are going to carry it on as it has been developed for the last hundred years, we must take advantage of every possibility to add one kernel more to the sum of human knowledge, so that we may advance properly, that we may maintain our hold upon civilization, and that we may ferret out still further the secrets of nature, which are absolutely essential for the maintenance of man.

The forests of Canada rank second only to agriculture in the value of their products; they are the source of one quarter of our export trade; they provide 20 per cent of the entire freight haulage on Canadian railways and in addition substantially augment passenger traffic earnings by the attraction of tourists; they provide direct employment for over 97,000 workers and furnish salaries and wages to the total of over $100,000,000 per year.—*Natural Resources, Canada.*

Concerning Some Contracts Often Used

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THE contracts most frequently used by Electric Utilities are of three main types, namely, contracts for sale of goods, contracts for work and labor, and service contracts.

The first type appears in many forms. The contract may be for the sale of a single article like an electric iron, with no record in writing between the parties—just delivery of the article for cash. It may be the sale of a range on instalments and may be comprised in a written agreement. It may be for the supply of a quantity of appliances to be delivered at intervals over a period and may have to be built up from correspondence. These all concern articles that can be seen and touched.

Although electrical power or energy is not an article which can be seen or safely touched at the point of delivery, nevertheless a power contract is a contract for the sale of goods and is governed by the same laws, Metropolitan Electric Supply Co., Ltd., vs. Ginder, 1901, 2 Ch. 799. The peculiar nature of the subject matter requires special clauses as to equipment, regulation and other physical factors and this side of the contract is quite obvious to engineers. The other side concerned with the respective rights of the parties is not so obvious and may not be given a thought until a dispute arises. Then appeal is made to the law.

The distinction between the first and second type of contracts, between sale of goods on the one hand and work and labor on the other hand, may sometimes appear arbitrary on application but the principle of distinction is clear. It depends on the terms of the individual contract. When the substance of a contract is that a chattel shall be made and delivered when completed, the contract is one for sale of goods; that is, the main object is the transfer of a chattel as a chattel.

If the work and labor ends in nothing that can properly become the subject of a sale, the contract is one for work and labor and not one for goods sold and delivered. A contract for making and installing a set of store teeth is one for sale of goods, Smith vs. Surman (1829) 9 B and C. 561. On the other hand a contract to make and install an engine was held to be one for work and labor; Clark vs. Bulmer (1843) 11 M. & W. 243. The value of the materials as compared with the value of the work and labor is not the test. The distinction lies in whether the result of the work is delivered as a chattel or not. The distinction is important. In case of dispute the claim must be properly framed, or you will find some trying moments in court. In the case of the engine cited above, since the contract was not for sale of goods the purchaser

could not claim on a warranty as to the efficiency of the engine unless such were expressly made part of the contract.

The third type of contract, namely, service contracts, may be distinguished from work and labor by the degree of control exercised by the employer. If the employer not only directs the other as to the work to be done but also controls him as to the manner of doing it, the contract is one of service. This distinction is important because in the case of a service contract the master is responsible for the acts of the servant within the scope of the employment, i.e., if hit by a street car you sue not the motorman but the employer, the street railway company. Back seat interference with a taxi driver may make the driver your servant and not the servant of the taxi owner and then you can settle with yourself for the damages you suffer in accident.

Further, a service contract can only be terminated according to certain well-defined rules, e.g., a weekly notice for a weekly hiring. A contract for work and labor is not terminable on notice unless expressly so provided. A domestic servant cannot recover a month's wages in lieu of notice on account of work and labor. Fewings vs. Tisdale, 1847, 1 Excheq. 295. On the other hand a suit for work, labor and materials is the form of claim used by farriers, and surveyors, quoth Pollock, C.B., in Clay vs. Yates, 1856, i. H. & N. 73.

An intermediate type often requires watching, namely, agency. In the contract of agency there are certain limitations both as to the nature of the employment and as to the manner of carrying out the purpose of the employment which do not exist in a contract for work and labor. The work of an agent is essentially that of creating a legal relation between his principal and a third party. While executing the services indicated by the principal, the agent must keep within the scope of the authority delegated to him as defined in his agency contract and to this extent he is subject to the principal's control during his employmnet. The exceptions which prove the rule are political agents who seem to be a law unto themselves. No such limitation exists in the case of a person employed under a contract of work and labor; his contract only requires him to produce a certain result. It is always important to know whether you are dealing with the principal or an agent. For instance, if a quantity of poles were bought, presumably from a jobber selling on his own account, and only certain were accepted, the rest being culled, and then it turned out he was only an agent having no authority to allow culling, the third man from whom he was supposed to have bought the poles outright, could claim for the price of all the poles. The supposed independent contractor being only an agent was acting outside of his authority. The glowing representations made by the agent may be outside the scope of his authority and therefore not enforceable as warranties against his principal. Again an agent may be able to contract only within certain limitations. A wife, while being with her husband, is able to pledge his credit for necessaries, i.e., "charge it." But where

things ordered by a wife are not necessaries for which it is presumed that she has her husband's authority to pledge his credit, either because they are not suitable to his style of living or are ordered in extravagant or excessive quantities, she will be deemed to contract on her own behalf, especially if she has separate means, in the absence of clear proof of an intention to the contrary. This might happen in the sale of certain electric appliances. On the other hand, if the wife is carrying on business on her own account, e.g., a bake shop, she is the party to sign the contract for electric service, i.e., as consumer.

In addition to the law governing ordinary contracts, those entered into by Municipal Electric Utilities are affected by special statutes, such as The Municipal Act, The Public Utilities Act, and The Power Commission Act. The particular effects can be shown in better perspective by introducing them at the appropriate places in a brief outline of the essentials of an ordinary contract.

The law of property had its origin in the attempt to ensure that what a man has lawfully acquired he shall retain whether he wears it on his back or temporarily hangs it on the limb of a tree.

The law of contract is intended to ensure that what a man has been led to expect shall come to pass, that what has been promised to him shall be performed. Apparently there never was a binding contract for Nickle beer. A contract is an attempt to harness the will of another human being, something as uncertain as the weather. It is an attempt to bind future conduct and capacity.

There are two inseparable ideas, namely, Agreement and consequently Obligation.

Not every agreement is foundation for a contract. The agreement must be "the expression by two or more persons of the common intention to affect their legal relations". The intent must be distinct and common to both or to all if more than two. The intent must be communicated. It must refer to legal relations. It must affect the parties themselves.

The obligation arising from agreement implies control over the acts of another. It implies definite parties and also definite acts or forbearances. These must be capable of pecuniary measurement.

There are five lines of enquiry to pursue in determining whether there is a contract or not. These are :

1. Offer and Acceptance.
2. Evidence, i.e., form or consideration.
3. Capacity of parties.
4. Genuineness of consent.
5. Legality of objects.

First, Offer and Acceptance. Every contract may be analyzed as commencing with an offer and an acceptance. There must be a definite offer. A mere statement of intention is not sufficient, e.g., that I intend to sell my car (if I had one). Nor on the other hand is it sufficient to state willingness to enter into negotiations, e.g., How much am I offered for the Ford 1914 vintage ? Neither can be accepted. Neither can an announcement of a competition, a statement of lowest price or an ad-

vertisement for tenders. These may be anterior but cannot make foundation for a contract, e.g., when tenders are advertised for, the party who answers puts in a tender which is the offer and this is accepted by the party advertising.

The offer must be made by a definite person. It may be made to an indefinite number as in case of offering a reward but must be accepted by a definite person.

An offer may be revoked at any time before acceptance provided the revocation is communicated to the person by whom the offer was made; Byrne vs. Von Tienhoven 1880, 5 C.P.D. 344. Goodison Thrasher vs. Doyle 28 O.W.N. 314. Great Northern Ry. Co. vs. Witham 1873, L.R. 9 C.P. 16.

This, of course, is only where the offer is not under seal. An offer under seal cannot be withdrawn.

On the other hand, the acceptance is complete upon mailing if no other special way is prescribed. Dunlop vs. Higgins, 1 N.L.C. 381. The acceptance must be absolute and must correspond with the terms of the offer, e.g., a reply in the affirmative, subject to terms of contract being arranged, is no acceptance, only an expression of willingness to treat, i.e., negotiate not inebriate.

As to evidence certain requirements must be met. A seal on an offer preventing revocation has already been referred to. This is an inheritance from previous centuries. Once men executed by seal, not signature, and today something of the old solemnity still clings about a seal. An ordinary promise to pay may be barred in six years, but a promise to pay under seal may be sued on any time within twenty years. A seal imports consideration.

Consideration for a promise is necessary to make the promise binding. In other words there must be mutuality. Consideration has been defined as something done, forborne or suffered or promised so to be by the promisee in respect of the promise. Detriment or loss to the promisee is the test. It need not be adequate in the opinion of third parties but must be of some value in the eyes of the law. It must be present and not past. If past, the value is presumed to have been already received and done with. The consideration must be something more than the promisee is already bound to suffer or forbear. It must not be merely a motive, e.g., executors carrying out wishes of deceased.

The following will not do: An impossible act; one of no legal obligation; a promise to perform a public duty; or a promise to perform a contract already made.

Payment of a smaller sum in satisfaction of a larger sum is not a good discharge of a debt. There must be some other element introduced such as giving time or giving some other form of satisfaction, e.g., mining shares.

A gratuitous offer cannot be enforced as a promise but once started must be properly performed. A promised X to build a warehouse by a certain day. X sued A for delay, and also for increased cost by reason of the new materials used instead of employing the old materials. The promise was gratuitous and therefore there was no liability for delay, but

having entered on the work and by not following orders having increased the cost, therefore A was liable for misfeasance and damages were assessed. Elsee vs. Gatward, 5 T.R. 143.

Certain contracts must be in writing. By fourth section of the Statute of Frauds, 29 Carolus II, caput 3, sec. 4 (which means passed in 1669) no action shall be brought to enforce a contract for the sale of land, or for an agreement that is not to be performed within a year, unless a note or memorandum in writing has been signed by the party to be charged or his agent. By the Sale of Goods Act, 1920, 10-11 Geo. V., 5.40, s-6, a contract for the sale of any goods of the value of $40.00 or upwards shall not be enforceable by action unless the buyer shall accept part of the goods so sold and actually receive the same or give something in earnest to bind the contract or in part payment, or unless some note or memorandum in writing of the contract be made and signed by the party to be charged or his agent in that behalf.

The third line of enquiry concerns the parties to a contract. There must be at least two distinct parties. There can be no contract between two branches of the same organization nor between a partner and his firm for business of the firm. A mortgagee selling under power of sale cannot himself purchase at the sale nor can a vendor selling under a lien. A man cannot contract with himself any more than he can pay himself out of his own pocket.

The parties must be definite persons. A contract purporting to be made on behalf of a proposed company is void and cannot be ratified even when company has been incorporated.

As mentioned above the acceptor need not be known when the offer is first made, but must be a definite person at time of acceptance. A definite person must answer the advertisement with the dog to get the reward.

Where there is more than one party on one side of a contract the liability may be joint or several or both. When a single promise is made by several or to several there is only one obligation. Performance made by or to one discharges that obligation. The same result takes place in case of a suit. A judgment against one on a joint liability discharges the others. For this reason, it is important to choose the right one, i.e., the one with the money, when suing two or more joint makers of a note. Again it is important to note that if the liability or obligation is joint, all of persons liable must execute or none is liable. Conversely if one of several to whom jointly an obligation is owing fails to join as a party none can enforce. This, however, does not affect a firm, i.e., a partnership, because the partners are agents for the firm. One peculiarity of most of such joint relationships is survivorship, e.g. executors of a will, where the survivors carry on alone. This does not apply to a partnership because on death of one of several partners, partnership is dissolved.

If the obligation is several it means a separate obligation by or to each one and satisfaction of one does not dispose of any other.

Further, there is the joint and several obligation. In this case you can enforce the one obligation against any one of the several and if not then satisfied, e.g., if judgment cannot be realized then you can enforce the obligation against another of the several. If one dies his personal representatives remain liable because the obligation is several as well as joint. This applies to promisors not promisees, to those liable not to those to whom the liability is owing. It is most important whether you are claiming on a joint and several obligation or only a joint obligation.

When dealing with persons it is necessary to see that they are properly described for purpose of identification and evidence, but this is comparatively simple. It is when one deals with organizations that greater care is needed. There are many unincorporated associations with which it is difficult to make sure that the contract can be properly enforced, e.g., U.F.O. Club. With ordinary clubs there is no liability on the members beyond that in their rules, and the payment of their subscription. The committee as such is not liable. If goods or service be ordered, only the individuals who gave the order or authorized it or ratified it are liable and then only personally. If the one giving the order gave it only as agent for the association, then there is no one who can be sued. In the eyes of the law the association has no separate existence.

This is a danger one is apt to meet in contracts for electric service or sale of appliances. Most careful inquiries should be made in the case of unincorporated clubs, trade, marketing, or growers' associations, clubs, charities, volunteer corps, lodges; and sometimes in the case of churches enquiry is necessary to ensure the signature of the proper persons to bind the organization.

There are certain persons who have not the capacity to contract as individuals. The alien enemy is barred by statute. An infant under 21 years of age ordinarily is not bound except in case of necessities supplied to him. He may sue for wages due him any time within six years from the time he comes of age. A lunatic is not bound. A person under the influence of liquor is released if the other party knew of his condition.

A contract between two parties is limited in its effect to those who are parties. It is their private affair. It does not concern third parties nor can it affect third parties. Price fixing is contrary to law; the trouble lies in proving it. There is one exception, however, that is in the case of a patent. In a recent case before the Supreme Court of the United States it was held that during the life of a patent the holder had a monopoly and could control prices and also the manner of use.

When a corporation is a party to a contract several considerations must be given attention. First, Is the subject matter within the powers of the corporation to undertake? Apart from statutory enactment a right-of-way cannot be acquired over a railway. Next, Is the corporation authorized to do business within the jurisdiction? An American company must obtain a license to do business in the Province under The Extra

Provincial Corporation Act. Third, Has the corporation properly authorized the contract ? Have the by-laws been complied with ? If required, has the contract been sanctioned by the directors at a meeting, and, further, have the shareholders ratified it, if such be necessary. Fourth, Has the contract been properly executed ? The seal must be affixed and should be attested by the signature of the proper officers duly authorized either under a special by-law or the general by-laws of the corporation.

Still greater care is necessary when dealing with municipal corporations and also municipal commissions. This may be coming rather close to home but there are certain things that must be watched. A municipal corporation is a creature of The Municipal Act and strictly limited to its statutory powers. Except in certain instances expressly provided for such as waterworks, its jurisdiction is strictly limited to its own territory. The reconstruction of a building moved to make room for a street is not authorized under the Act. Its powers are delegated to it by statute and unless expressly authorized it cannot delegate its powers. If on road work, the engineer orders extras, the poor contractor ordinarily cannot recover : Dufferin Construction Co. vs. Grey, 22 O.W.N. 458. Since the corporation is purely statutory anyone dealing with it must at his peril enquire whether the subject matter of the contract is intra vires. If authorized only to produce and sell electricity it cannot buy and sell. Ottawa Electric vs. Ottawa, 21 O.I.R. 290.

It is also essential to see that the proper procedure has been observed. No debt may be incurred without a vote of the electors which is not to be provided for in the estimates for the current year and it has been held that this means a liability under which the municipality would have to pay in succeeding years. If the aggregate of rates for current expenditure and for debt and interest exceeds $2\frac{1}{2}$ cents in the dollar, then the council shall not contract any further debt until the annual rates are reduced to that rate.

A council must exercise its powers by by-law. The exceptions are (1) when its authority is derived elsewhere as from another Act ; (2) small matters, e.g., hiring minor services ; (3) routine matters. Note : A by-law authorizing a loan for a certain purpose does not authorize the carrying out of the purpose. The latter must be provided for by by-law. Wigle vs. Kingsville 1897, 28 O.R. 378. A contract entered into without a by-law is not binding on the municipality, MacKay vs. Toronto, 43 O.W.R. 17. To be validly executed the corporate seal must be affixed.

A municipal commission under The Public Utilities Act is a body corporate, therefore, it must execute contracts and other instruments under its corporate seal. It exercises all the powers, rights, authorities and privileges which are conferred on the municipal corporation by The Public Utilities Act, and therefore should similarly act by by-law.

The fourth line of enquiry is concerned with the reality of consent. The following are reasons for disput-

ing the reality of consent, namely, mistake, misrepresentation, fraud, duress, undue influence. If the reality of consent can be upset there is no agreement, the parties have never been ad idem, of one mind.

Cases of genuine mistake are very rare. What sometimes seems a mistake usually turns out to be the act of a third party, or the dishonesty of one of the parties themselves. The act of a third party may be illustrated by a telegraph inaccuracy or misprint in an advertisement.

In the case of misrepresentation distinctions must be drawn. If the representation did not become a substantive part of the contract its untruth was immaterial at common law. If it did become a substantive part of the contract it might be one of two things : (1) it might be regarded as a vital term going to the root of the contract and then the injured party might repudiate the whole ; this is sometimes called a condition ; (2) it might be an independent subsidiary promise usually called a warranty, which is indeed a part, but does not go to the root of the contract, in which case the remedy is an action ex contractu for damages, e.g., where the seller gave the purchaser a written receipt for the money describing the horse as a bay gelding got by Cheshire Cheese, warranted sound, it was held that the warranty was confined to the soundness of the animal and did not extend to the description of his parentage.

For fraud, intent must be proved, untrue conclusions induced by the representations of the party who made them, knowing them to be untrue and intending to deceive.

Duress occurs when the consent has been extorted by actual or threatened force. It was originally personal violence, hence a wife had at one time to be examined separately from her husband to prove that her bar of dower was voluntary. This is the case still in wild and woolly Saskatchewan. In more civilized communities other means of force are in vogue, e.g., refusal by a railway to carry goods unless its exorbitant charges were paid. Happily this cannot occur in Canada under our Dominion Railway Board.

Undue influence occurs where one is morally incapable of resisting the will of another, as where a man makes over all his property to his wife though there is no fear of creditors. It usually is a danger signal of the wife's intention to decamp.

The fifth line of enquiry is the legality of the object. This should be distinguished from the capacity of the party. Again distinction should be drawn between that which is unlawful and that which is merely void ; in the first case any consideration or covenant even under seal is tainted and cannot be enforced ; if merely void a security given for payment of debt arising out of the contract is in the same position as any other promise made without consideration and if under seal can be enforced.

A contract is illegal where the subject matter of the promise is illegal or the consideration, or where the subject matter is part of a larger transaction of which the object is illegal, e.g., sale of drugs for purpose of brewing beer contrary to Act of Parliament, or the letting of rooms

for blasphemous lectures or other purposes contrary to good morals.

The subject matter may be made illegal by statute, such as the sale of a composition as maple syrup, a contract contrary to the Gaming Laws or the Lord's Day Acts, or other acts that will readily suggest themselves. In such cases the result is to make the contract void.

The subject matter may be illegal at common law. It may be an indictable offence or a civil wrong—an agreement to beat up a man or to commit a fraud or a libel. It may be contrary to the policy of the law—the sale of public offices. Lloyd George's private campaign chest must have been filled by cash transactions. It may be a perversion of justice as was suggested in a recent sensational case centering around a red-haired faith-healer, or the ancient offence of embracery which is not what it might be thought, but rather is, the act of corruptly influencing a juryman. Another and commoner example is restraint of trade like the fruit combine out in the West.

The results may be (1) do the act at your peril and pay the penalty; (2) render the contract void; (3) make the contract void and penalize the party attempting.

If the contract has been entered into and is enforceable the next consideration is performance. The contract may be entire or divisible. If entire the whole must be performed before the consideration is earned. A contract to convey a passenger from London to York must be wholly performed or no pay is due; the owner of the coach is not entitled to any remuneration for conveying his passenger part of the way. If the contract is entire the party failing to complete cannot recover even on *quantum meruit*, i.e., for the part performed, and besides is liable in damages for non-performance.

There are four main excuses for non-performance: (1) impossibility, (2) illegality, (3) prevention by one of the parties, (4) waiver by one of the parties. The last is the most frequent and one that must always be carefully guarded against. Waiver frequently comes in question in relation to time.

A contract may be discharged in several ways. The first is waiver, but this only applies where the contract is wholly executory, i.e., both promises are still to be performed. It cannot apply if there has been part performance. The second method is a substituted contract. A mere postponement is not sufficient. The third method is where the contract expressly provides for discharge, in which case the provisions must be strictly followed. The fourth method of discharge is by performance. The fifth is by breach; this may occur by renunciation or by failure.

Where a contract is discharged by breach, anything done after breach is only available in mitigation of damages and cannot be relied on as in any sense part performance.

Where one party has disabled himself from performing or has repudiated the contract, the other party is entitled to treat the contract at an end, and he is not only entitled to damages, but also, if he has performed his obligation in whole or in part, he has a right to sue on a *quantum meruit* for what he has done,

but this latter, not from the contract which is at an end, but from an implied promise by the other party arising from his acceptance of the executed consideration.

Breach always gives rise to an action for damages. In certain cases where damages would be inadequate and the court can, with its limited machinery, enforce its decree, specific performance may be ordered. This is limited almost entirely to cases dealing with land.

As shown above the main remedy for breach is an action for damages. In certain cases specific performance will be ordered. In special cases an order may be made for cancellation or rectification.

Discussion

Mr. D. B. McColl, Walkerville :

Mr. Hanna, in selling particular appliances, if the name of the seller is on the appliance, is that sufficient without registration ?

Mr. Hanna :

In the Conditional Sales Act, it specifically provides that, when the name of the maker is clearly marked on the article, that is sufficient warning and the registration of a lien contract is not necessary, but the name must be clear and distinct. There is a case of some fifteen years' standing—Ericson vs. Elk Lake. The Erickson Telephone Manufacturing Company, a Buffalo company, sold a switchboard to a company near Cobalt, and later the Elk Lake Telephone Company purchased it second-hand. There was no lien registered. There was considerable owing from this other company, and the Erickson Telephone Company sued. The name plate said, "Erickson Tel. Mfg. Co." The case turned on whether the name was clearly marked, and it was decided that the name-plate was misleading. The lettered "Tel." might have meant "Telegraph" or "Telephone." The Act must be strictly complied with. The company could have protected themselves by registering their contract. They no doubt thought they were complying with the Act sufficiently, but in their name-plate they had not complied with the Act, and they could not collect. That case also brings out another interesting point while I am on my feet ; a point, however, that never was raised in the case, namely, what law governed the contract, the law of the Province of Ontario or the State of New York. The case was decided on the basis that the contract was subject to Ontario law. The circumstances might have been sufficient to have made the original contract of sale subject to New York State law. Then, the result might have been different. When buying goods from outside the Province, even from the Province of Quebec, make sure as to where the contract is made and where it is to be performed.

Mr. J. A. Harris, Toronto :

Supposing the agent of a company called upon a consumer and told that consumer that it would cost a certain amount of money to extend a line into his property in order to provide service. He asked that consumer, if agreeable, to forward an order to the

company. The order was sent, stating, we will say for the matter of illustration, "Please supply the necessary labour and material, in order that a pole line may be constructed for a certain specified territory to supply a service to a particular class, for which I agree to pay the sum of .... and deposit herewith the sum of ......" It is not accepted in so far as a written agreement is concerned by the company; but part performance is entered upon, and part performance is considered by the consumer only. We will say, for instance, it was specifically mentioned in the order that the poles shall be painted green, and when the job was completed the poles were not painted green. Could that consumer force me to paint those poles green? There is no written acceptance by the company, but that is only part performance of the agreement.

Mr. Hanna: From the facts you quote, the contract would appear to be one for work and labour and not sale of goods, so writing would not be compulsory under the Statute of Frauds. Nevertheless the customer set out his requirements in a written document and the Utility undertook performance; therefore the Utility before trying to collect pay for work would have to complete what was set out in the document unless the contract were divisible, *i.e.*, made up of several parts that could be separated and the Utility could collect for those parts it did complete. If it were indivisible or what is called an entire contract, the Utility would have to complete performance before becoming entitled to any pay. The point as to green paint seems a minor item and the consumer might have difficulty in proving any loss or damage. The Court might take a reasonable view and allow a reasonable deduction from the price of work for the consumer to apply his own green paint.

Mr. Harris: That covers the point. But what I wanted to further state is that that was a common order in utilities. It used to be common for Utilities to receive those orders from customers. We found it necessary to place on the order "Accepted for the Company" at the bottom. That completed the written agreement; but, otherwise, there was no written agreement.

Mr. Hanna: I think I have seen some of those very agreements of which you speak. The Utility had had considerable experience and realized clearly the necessity in such cases of getting a document. The document in question was only a small sheet of paper, but it did cover the difficulties that the Utility had experienced.

Mr. W. Ellis, Hamilton:

Mr. Hanna, in your explanation of the sale of the Telephone Company board, the Erickson, you stated that the name of the maker must be distinctly marked on the article before they could claim. In handling an article made by a certain firm, if the sales agent puts his name on that article to secure himself against the possibility of loss in the case of a second deal, does that cover just as well?

Mr. Hanna: I think that is the same thing. The manufacturer protects himself by putting his name on. You are dealing with merchandise

in electric stores, and in handing out an article as an article of merchandise, you put your name on.

Mr. McColl: In that case, you would have to go back and find out whether the seller had a lien?

Mr. Hanna: Yes.

Mr. McColl: And say it was a Moffat range, you would have to go back to Moffat's and find out if they had a lien. Supposing it was an article that was sold on lien to one purchaser and then sold by him again, you would have to go to both people to find out if either one had a lien.

Mr. Hanna: Ordinarily, yes.

Mr. McColl: That would apply more to makers.

Mr. Hanna: Much more so. On the other hand, it is ordinarily presumed that, when a storekeeper is selling an article of merchandise, that he has full authority to sell it, as a factor or jobber, and the purchaser from him is clear of the manufacturer. But in the case of motors, it is essential to make sure the man you are dealing with has cleared himself with the manufacturer whose car he is handling, or is an authorized agent.

Mr. Harris: I would like to ask, is it possible for a Utility and a consumer to contract themselves out of a statutory reference? I might give an explanation. A statement in the Electricity Act states that a certain error is permissible in meters, but recovery by the consumer or Utility is limited for a period, which, I believe, is three months prior to the date of discovery of the error. Supposing that an agreement had been made whereby the limitations, as set forth in that agreement, and also the percentage of error of the meters was different to that as set by the statutes, would that be considered to hold good in law, in view of its contradicting the reference in the statutes?

Mr. Hanna: Ordinarily it is possible to contract out of a statutory enactment. If any of you ever signed an ordinary house lease, you will find in there a clause by which you pledge your goods without exemption, to the landlord, notwithstanding anything contained in the Landlord and Tenant Act protecting you for exemptions, and that is possible. Now under The Mechanics Lien Act you cannot make such a contract with a man because that Act specifically says that, irrespective of any agreement that the statute shall not apply, nevertheless the statute shall apply; therefore no court in Ontario can enforce any agreement to the contrary.

The particular instance chosen by Mr. Harris is somewhat different, because you are dealing with a Dominion Statute; that is, the Electricity Inspection Act. The Parliament of Canada has jurisdiction over the inspection of electricity. By the terms of that Act, a purchaser of electricity may demand delivery under certain conditions and certain terms, and through a certain type of meter, which will be subject to the inspection of that Department. That is under the control of the Department at Ottawa. The situation is not satisfactory, because the Act is some twenty years old, and scarcely provides adequate methods for increasing complicated power loads of to-day.

Electric Range Elements

By G. J. Mickler, Sales Dept., H.E.P.C. of Ontario

(Read before the Association of Municipal Electrical Utilities at Niagara Falls, June 24, 1927)

SO much has been said about the speed of electric range elements; so much has been advertised about the "speediest", "quickest" or "fastest" elements; so little is known by sales folks and prospective customers alike about what electric range elements will do if given half a chance, and how the performances of the various types of elements compare with one another that it is a wonder any cooking devices equipped with these contrivances are ever sold to the public.

I believe that many electric ranges are sold to-day in spite of what customers are told by over-enthusiastic salesmen and manufacturers, because to ask these same individuals what their particular type or range element will do, they will simply answer, "Fastest thing you ever saw:" "Beats so-and-so element to a frazzle;" "Quicker than this and that;" but never do you see them show any reliable test data to back up their remarks; and these remarks are repeated so frequently that the salesmen soon believe them regardless of what is actually true.

I have carried on tests at various times to permit a comparison to be made of one element with another, but the rapid development that has taken place during the past few years, and the many new types of elements which have appeared on the market, have rendered all previous tests more or less valueless.

To satisfy an increasing desire for accurate information as to the relative merits of the more important elements with which ranges are equipped to-day, it was decided to pick out an element of each type of the capacity generally regarded as the principal element on a range, and subject each to a heat run test; and with the aid of electrical and thermal instruments record the performance of each and picture the comparative records by graphic illustrations.

In these tests it was not the desire to discredit the products of any manufacturer. Care has been taken before bringing out the facts contained in what is to follow, to see that every range manufacturer of note in Ontario is to-day making both open and closed elements, and equipping his ranges with such; so that no harm can be done to any manufacturer by making a comparison between open and closed elements. What follows is really a comparison between these two types. The purpose of these tests is to illustrate as far as possible the comparative efficiency and performance of open and closed elements, and to give to those engaged in the sale and demonstration of electric ranges some material which will enable them to convince prospective customers of the ability of electric range elements to perform efficiently and economically the service for which they were intended.

It is remarkable how little information is actually imparted by manufacturers of ranges to those engaged in selling their products. I had occasion to call upon two or three large establishments where electric ranges are sold, to find out what arguments are used to sell different types of ranges, and to find out also what material is supplied by manufacturers to the salesmen in these establishments to back up the statements made in the advertisements which appear almost daily in the press. In all cases the salesmen, in answer to questions as to the speed and efficiency of the elements which they are endeavouring to dispose of, made the simple statement that this range or that range does this or that because the manufacturer says so.

There are a few manufacturers who put out instruction books and cards which give information as to how to operate the elements on their ranges to give satisfactory results, and economical operation, but they do not carry their instructions far enough. By the use of the curves which follow, salesmen and demonstrators should be able to better instruct their customers on how to use the elements of their ranges to get the most out of them, and at the minimum cost.

SET-UP OF TEST.

The set-up for the test consisted of a standard voltmeter, a standard ammeter, a resistance for voltage regulation, a standard Centigrade thermometer with an adjustable stand to permit the thermometer being raised or lowered at will, a hot plate frame equipped with a three heat switch, an $8\frac{1}{2}$ in. copper tea kettle and a standard Imperial quart measure as well as a 110-220 volt circuit regulated to maintain 115 volts with the element switch on high.

The test was conducted on four so-called open elements, consisting

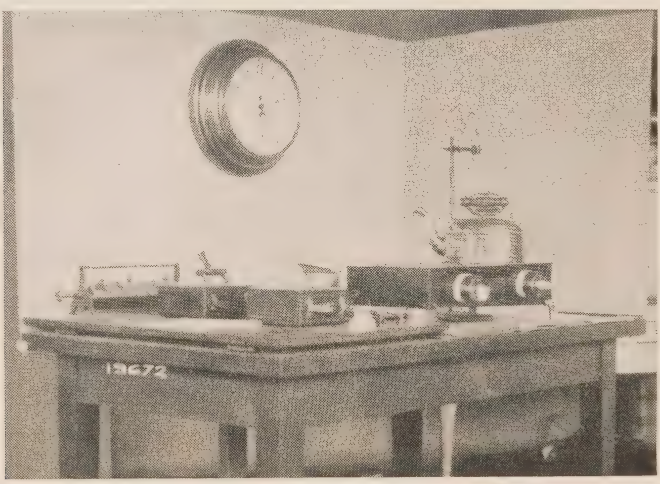


Fig. 1—Showing set-up for test.

of Nichrome coils laced through porcelain grooved blocks, each being of a distinct type, distinct because each manufacturer, in order to circumvent the patents of the other is generally forced to adopt a design of his own. There are also seven so-called protected elements ; that is, the elements or heating coils in each were protected either by a covering or tubing, or a metal plate to protect them from outside abuse. All of these elements are the products of reliable Canadian electric range manufacturers.

METHOD OF TEST.

Taking one element at a time, the following test was made : using an Imperial quart of tap water in the $8\frac{1}{2}$-in. copper kettle, temperature of the water being usually 9 deg. Cent., and with the element cold, that is at room temperature, the current was turned on at high heat, the voltage adjusted to 115 volts, and the thermometer lowered to within about $\frac{1}{4}$-in. of the bottom of the kettle, and readings were taken of the temperature of the water at one minute intervals until the boiling point was reached.

When the water was brought to a boil the current was turned off and the element allowed to cool, usually over noon hour or over night after which two quarts of water were placed in the kettle at 9 deg. Cent., and the operation repeated, taking readings of the thermometer at one minute intervals until the boiling point was reached. In a similar manner, after the element was cooled again, three quarts of water were placed in the kettle at 9 deg. Cent. and the current turned on and readings taken every minute up to the boiling point.

After this third test the element was considered a hot element, that is, about as hot as it would become in ordinary domestic service, provided it is not left on high heat without a utensil on top of it.

With this hot element, then, another series of tests was carried on, putting one quart of water at 9 deg. Cent. into the kettle which had been previously cooled off, and with the current still on the element at high, temperature readings were taken on this quart until the boiling point was reached. In a similar way two quarts of cold water and three quarts of cold water were brought to the boil on the element hot.

RESIDUAL HEAT.

After this test was made, in order to find out the amount of residual heat in the elements after the current is turned off, three quarts of cold water were placed in the kettle, and this placed on the hot element and the current turned off, and temperature readings taken every minute up to the point where there was no further rise in the temperature of the water.

In all of the above tests the lid of the kettle was open to permit reading the thermometer at the lower temperature.

Another test was made to show how long after turning the current off when three quarts of water had been brought to the boil, the boiling operation would continue. In this case readings of the thermometer were taken until the temperature had dropped below 99 deg. Cent., at which time active boiling or circulation of

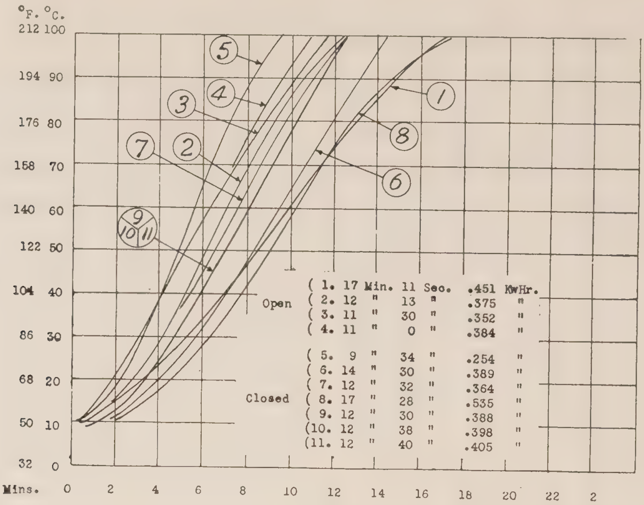


Fig. 2—Time required to boil one quart of water from cold start.

the water in the kettle had ceased. In this case the lid of the kettle was closed, and the thermometer inserted through an opening in the lid.

A still further test was made on closed elements with a metal plate covering to show the effect of improving contact between the surface of the element and the bottom of the kettle by pouring water on the cold element, also by pouring mercury on the cold element and comparing results when boiling one, two and three quarts of water on a cold element.

When all these tests had been completed the results were plotted, the curves drawn and calculations made to show the time required by each element to perform each function, also the number of kilowatt hours of energy expended in performing each operation, and the following graphs illustrate in a comparative way how the various elements performed all of these operations.

One Quart.

Fig. 1 is an illustration showing the set-up for the test. This is just as a matter of record, and will serve as a guide in making up future tests. Fig. 2 graphically illustrates the performance of each of the eleven elements when boiling one quart of water from a cold start. A close examination of this graph shows that closed element No. 5 boiled one quart of water in 9 min. 34 sec., with a consumption of .254 kw-hr. Then three open elements come along with 11 min., 11 min. 30 sec., and 12 min. 13 sec. respectively, after which the other closed elements and the remaining open elements did their job. It will be seen also that open element No. 2 and closed elements Nos. 7, 9, 10 and 11 are practically on top of one another, and it will also be seen that element No. 4 consumed .384 kw-hr. which is considerably more than that

consumed by some of the other elements. It was found that this element was very much over-rated ; that is the reason why perhaps it performed a little better than some of the others.

Some other interesting information can be gleaned from this and the two following graphs, in that they show that some of the closed elements take a somewhat longer time to get started, whereas the open elements show a temperature rise much more rapid at the start, due to their coils being more or less free to exert their energy upon the kettle as soon as the current is turned on. One interesting point that it might be well to note is that No. 2 and No. 7 elements, which are practically the same rating, come together at the boiling point, No. 2 being an open element and No. 7 a closed element. These elements are manufactured by the same maker, and afford an interesting comparison as to the speed of open as compared with closed elements.

Two Quarts.

Fig. 3 graphically illustrates the performance of each element in bringing two quarts of water to a boil from a cold start. Here again we notice that element No. 5 is somewhat ahead of the rest, followed closely by No. 4, which is again the high capacity element, two closed elements No. 9 and 10, another open element, then two more closed elements, two more open elements and finished off with two closed elements. A study of the kilowat-hour consumption of each element shows that No. 5 is away in the lead, with No. 8 following far behind.

Here again it will be well to notice the comparative results of element No. 2 and No. 7. In this case it will be seen that No. 7 element is almost one minute ahead of No. 2, and shows that the closed element is that much faster than a corresponding open element.

Three Quarts.

Fig. 4 shows graphically the performances of all of the elements in bringing three quarts of water to a boil from a cold start. Here again

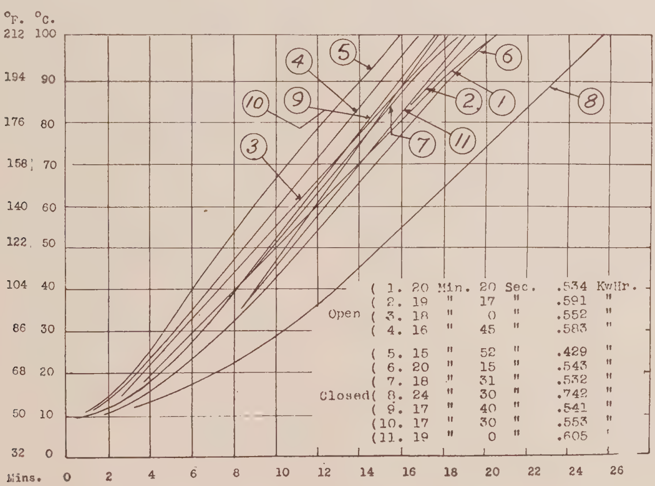


Fig. 3—Time required to boil two quarts of water from cold start.

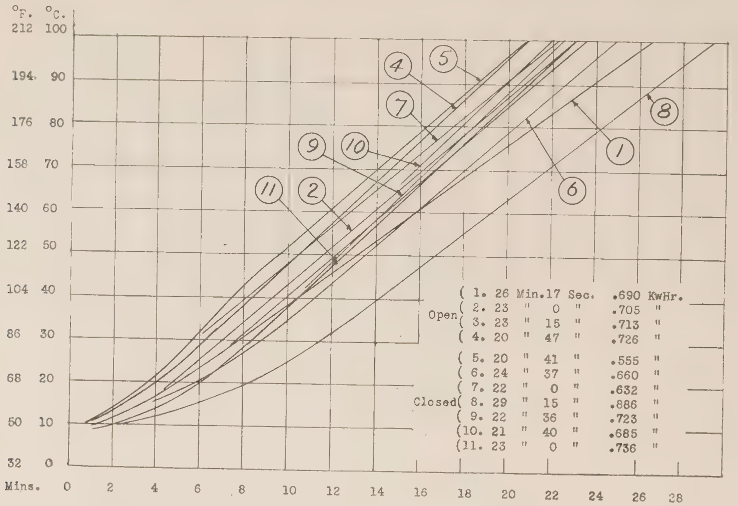


Fig. 4—Time required to boil three quarts of water from cold start.

No. 5 arrived at the boiling point ahead of the rest, followed by No. 4, then by No. 10 and two other closed elements, then No. 2 and 11, an open and a closed element, then No. 3, an open element, No. 6 a closed element, No. 1 an open element, and finally by No. 8.

This graph gives another comparison between elements No. 2 and No. 7, No. 7 being one full minute ahead of No. 2, or roughly 5 per cent. faster.

It might be well to explain that the reason No. 8 element shows such a poor performance is that with the kettle which is perfectly flat and with an element that is not perfectly flat, the contact between the two not covering a very large area, the radiation from the element to the kettle and into the water was a very slow process. Apparently the air space between the element and the kettle and the possibility of circulation of air carrying off the heat slowed up the operation very materially.

Hot Element, One, Two and Three Quarts.

Fig. 5 graphically illustrates the performance of the elements in bringing one quart of water to a boil on a hot element. In this case we have three closed elements out in front, followed by No. 4, the high capacity

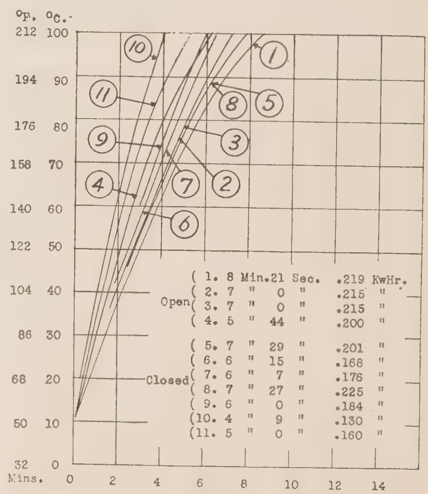


Fig. 5—Time required to boil one quart of water from hot start.

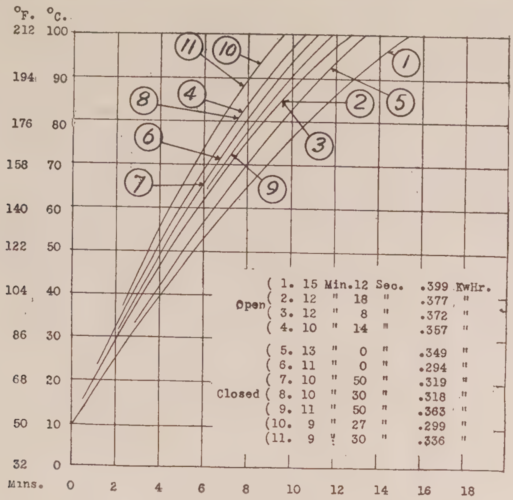


Fig. 6—Time required to boil two quarts of water from hot start.

element, then by No. 6 and 7, closed elements, by No. 3 and 2 open elements, by No. 5 and 8 and finally by No. 1. It will be seen that No. 5, which was in front in the cold tests, is now pretty well to the back.

Fig. 6 illustrates the performance of the elements in bringing two quarts of water to a boil from a hot start. In this graph we see that elements No. 10 and 11 are the first to arrive, both closed elements. Then come elements No. 4 and 8, one open and one closed, then No. 6, 7 and 9, closed elements, No. 2 and 3 open elements, No. 5 closed elements, and finally No. 1.

Fig. 7 shows the performance of the elements in bringing three quarts of water to a boil from a hot start. Here again closed element No. 10 is in the front, followed by No. 4, 11, 8, 9, 10, and 6 in order, then Nos. 2, 3, 5 and 1. This series of tests on hot elements shows beyond a doubt that closed elements are considerably faster than open elements, due to their giving off evenly the heat stored in the element in the first part of the operation of bringing water to a boil. This is further illustrated by a comparison of the kilowatt-hour consumption in each of the three figs. 5, 6 and 7, which shows that with two exceptions the kilowatt-hours consumed by closed elements is less than that of the open elements.

On Fig. 7 are shown also the total number of kilowatt-hours consumed by all of the elements to perform all of the six functions of these tests, and while in some cases the open elements were a little ahead in bringing water to a boil from a cold start, this table shows that with one exception all of the closed elements performed all of the functions with a lower kilowatt-hour consumption than the open elements.

Fig. 8 shows to what extent different types of elements store up heat when the current is turned on. By placing three quarts of water on a hot element, turning the current off, and

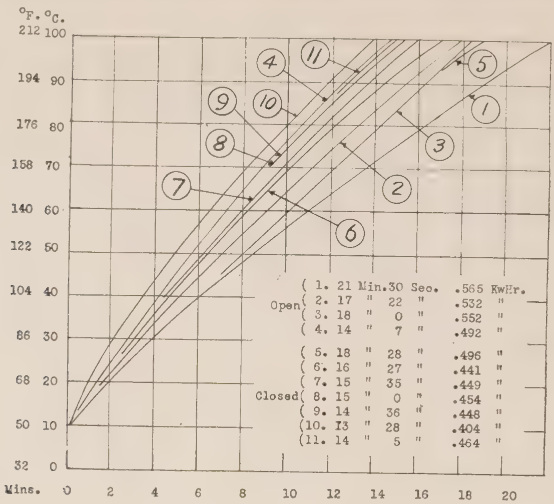


Fig. 7—Time required to boil three quarts of water from hot start.

observing the temperature rise of the water until the rate of rise was zero. When plotting these curves it is found that elements with a cast iron cover absorb a little more heat and give it off a little more readily than do open porcelain elements. The four upper curves on this graph are those of closed cast iron elements, the lower curves of open elements ; and while the temperature rise of one of the cast iron elements is shown as 63 deg. Cent., or about 140 deg. Fahr., the other cast iron elements are somewhat lower and not very far away from a porcelain, which brought water up to 122 deg. Fahr. This may answer some of the arguments about the absorptive power of porcelain as compared with cast iron. The general opinion is that porcelain does not absorb heat and all the heat generated by the heating coils passes through the air into the kettle and into the water, whereas cast iron elements take up a lot of the heat given off by the heating coils and hold it. It is true they absorb a lot of heat, but they give it

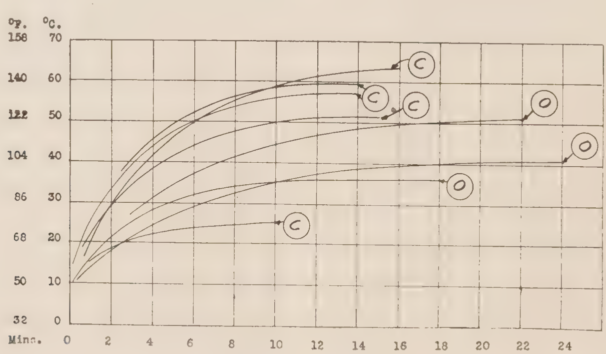


Fig. 8—Temperature rise of three quarts cold water on hot element.

off very rapidly, once they get hot. Porcelain is slow to absorb the heat, and it is just as slow to give it off, although these curves show that the amount of heat absorbed by the porcelain may be almost as much as that absorbed by the cast iron in some cases. This depends, of course, on the amount of porcelain and the amount of insulation beneath it. The same governs the amount of heat absorbed by cast iron plates.

An interesting feature of this curve is not so much that porcelain will absorb as much heat as cast iron but to show the value of the heat which is stored in an element, and which in many cases is lost if economical operation of a range is not carefully studied. If it is desired to utilize all the heat that is given off by a range element either open or closed, after certain boiling operations have been completed (and there are many times when it is just desired to bring water to a boil) the residual heat in an element should be made use of. That is to say, supposing the kettle is boiled for making tea. When sufficient water has been drawn off the kettle for the tea, it should be filled up with cold water, and this kettle full of water placed on the hot element. These curves show that in about the time that it takes to eat a meal there will be enough hot water to wash the dishes in the average home. If you put warm water in the kettle of course the temperature would be much higher at the finish than it is when you put cold water on, but with cold water at the start, the temperature rise to from 122 to 150 deg. Fahr. is as much as any one requires for dish washing purposes.

MAKING BETTER CONTACT

Fig. 9 shows what can be accomplished in the way of speeding up the operation of closed elements by the simple method of putting water on the element before turning the current on. It very often happens that warm water only is desired, that is, you do not want water brought to the boiling point for such operations as shaving or washing in which case water at 70 deg. Cent. is plenty warm to do the job, and by placing a little water on the element it was found that to heat one quart of water the operation was speeded up 40 per cent. over that on a dry element, that is up to 70 deg. Cent. With two quarts it is speeded up about 30 per cent, with three quarts about 25 per cent.

You will notice that the knee of each of these curves occurs at about 70, 65 and 60 deg. Cent., and it was found that in each case at this point all of the water had disappeared from the surface of the element. Different attempts were made to hold water in the elements for a longer time by grooving the elements, and by pouring more water on, but in each case the results were the same ; that is, after the element itself got beyond the temperature of boiling water it turned the water into steam, and it all disappeared.

MERCURY STILL BETTER.

To show just what can be accomplished in the way of increasing the conductivity through improving the contact between the kettle and the element, mercury was placed on the element in quantities sufficient to fill up the spaces between the element and the bottom of the kettle, and it was found, as these curves show, that

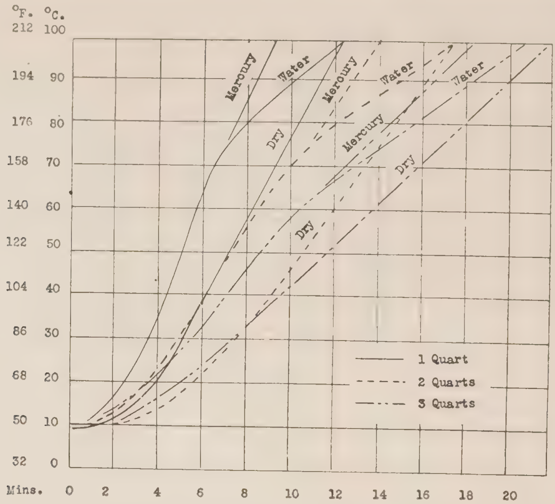


Fig. 9—Showing effect of using water and mercury to improve contact.

the boiling point of the water was reached from 20 to 30 per cent. faster by this method than with the element dry. The mercury did not disappear from the surface of the element but continued to act as a conductor and a contact improver until the boiling point was reached.

The practical value of mercury as a contact improver of course is not to be considered, but this test simply illustrates that an all-important feature in the design of closed elements is the contact between the element and the utensil placed upon it, and the more perfect contact that can be made between the two, the better will be the results achieved.

Summary.

The following table is a summary giving the consumption of each of the individual elements for the foregoing experiments shown on graphs Fig. 2 to Fig. 7 inclusive. These figures give a fair comparison between the elements as the duties performed can be considered diversified.

Type of Element	No.	Kw-hr
Closed	5	2.284
"	7	2.472
"	10	2.491
"	6	2.495
"	9	2.647
"	11	2.706
Open	4	2.742
"	3	2.756
"	2	2.795
"	1	2.858
Closed	8	3.160

A Practical Economy.

An interesting example of what can be accomplished in the way of economy in the operation of an electric range, is presented in the following table, which shows the consumption of a particular residence consumer over a period of two years. The installation in this particular residence consisted of a flat rate water heater, immersion type, a circulation type booster water heater, an electric grate, an electric washing machine, and the regular quota of smaller appliances and lights. On February

28th, 1927, an electric range was installed so that for the period January 28 to March 31st the consumption shown would include the consumption of a range for one month ; for the period from March 31st to June 1st the consumption includes that of the range for two months. The following is the table: kw-hr., the operator of the range was becoming accustomed to its use, not to the economies which could be effected otherwise by careful operation. Inside of a month, however, several tricks were discovered which would save current, the most important of which was that by utilizing the residual heat in the elements after

PERIOD.	CONSUMPTION.	NET BILL.
March 30—May 29, 1925	409 kw-hr.	$5.41
May 29—July 29	244 "	3.92
July 29—Sept. 30	379 "	5.14
Sept. 30—Nov. 30	474 "	5.99
Nov. 30—Jan. 28, 1926	677 "	7.82
Jan. 28—March 29	644 "	7.70
March 29—May 31	641 "	7.50
May 31st—July 30	467 "	5.93
July 30—Sept. 30	635 "	7.44
Sept. 30—Nov. 29	581 "	6.96
Nov. 29—Jan. 28, 1927	684 "	7.88
Jan. 28—March 31	817 "	9.08
March 31—June 1st	560 "	6.77

Average of above 556 kw.hr. and $6.75 for a two months period.

An examination of this table shows that for the last period, that of from March 31st to June 1st, 1927, the consumption is just about equal to the average for the two months period during the two years, and is little if any greater than the consumption for the corresponding periods in 1925 and 1926. In fact, in 1926 the consumption was greater than in 1927. A most satisfactory feature of this, is that a gas bill which amounted to an average of $3.00 per month or $6.00 for a two months period was wiped off altogether.

An explanation of the facts brought out in this table is that while the consumption for the period from Jan. 28th to March 31st is shown as 817 cooking operations had been performed, sufficient hot water was available most of the time to perform a great many kitchen functions, and whereas the booster circulation water heater had been used many times previous to the installation of the range to provide sufficient hot water for ordinary domestic purposes and had been consuming many kilowatt-hours in so doing, the booster is now seldom used, and by all accounts there has been sufficient saving in this way to operate the range without any additional cost whatever, and with a saving of a gas bill the equivalent of the entire electric bill or almost so.

Discussion

Mr. J. N. Wilson, H.E.P.C. of Ont.:

I would like to ask Mr. Mickler if he has made any comparative tests on gas and electricity for the heating of water ?

Mr. Mickler : I never contemplated making any comparative tests between gas and electricity, because we are not interested in gas, and it would be very difficult to make a test without a lot of scientific calculations. To get the equivalent of an electric range element you have to set up a pressure apparatus and a gas metering apparatus, which was not available.

Mr. C. S. Barthe, Canadian General Electric Co. :

I would like to ask Mr. Mickler if he checked the ratings on the element, to see what its consumption was ?

Mr. Mickler : I did, Mr. Barthe. I had the ratings for each of the elements. I had an ammeter and a volt meter for the tests, and checked the rating of each. I found that some of the elements were nowhere near their rating. No. 4 element was rated at 1710 watts. It took 1990 watts at 110 volts, and 2100 at 115 volts. There were some elements rated at 1750 watts, on which I could not get 1750 at 115 volts. Some, of course, were very close to their rating. It is impossible to get a uniform rating on all elements, as you all know. If you have 110 or 115 volts before you turn the switch, you might have only 95 or 105 when the current is turned on, so, unless you know how the manufacturer fixes his rating, you cannot tell whether his rating is right or not.

Mr. F. Gover, Orillia :

I would like to ask Mr. Mickler whether, in his opinion, those results would have been relatively the same for 95 volts or 100 volts ?

Mr. Mickler : That is something I never went into. I was interested only in a practical test under conditions which approximate those in the ordinary home. Now, low voltage is, in outlying districts, not normal ; at least, it should not be if the system is efficiently operated.

Mr. E. V. Buchanan, London :

Mr. Mickler should be complimented, I think, on the extensive tests that he has made on range elements. But I do not believe he has made his tests complete enough. I believe that entirely different results would have been obtained with different types of utensils. Now, that may not be perfectly obvious at first hand, but I know that one of the range manufacturers did find that. Mr. Mickler's tests were made with a copper kettle. Now, if he had used a tin kettle, or an aluminum kettle, or a graniteware kettle, those curves would have probably crossed and recrossed one another in different ways. This is due, I believe, to the different conducting and radiating qualities of the metal. Another set of tests could be made showing the use of different utensils, because the ordinary copper kettle that he refers to is not one perhaps most commonly in use. Then another set of tests might have been made starting with a cold element and warm water. A great many people are using flat rate water heaters in order to produce economies

both of money and time. They start their cooking by using hot water from the hot water tank, and it would be interesting to see the results using water in that way. Then again, Mr. Mickler said economies could be effected by cooking vegetables with the element shut off, entirely and using the residual heat. I don't think that is a common practice, however. I think the common practice is to turn the switch to low and allow the cooking to go on in that way. Now, it might be interesting to see the amount of current necessary to evaporate a certain quantity of water after the boiling point had been reached, and with the switch turned to low. I am not wishing a job on Mr. Mickler but I do think such tests as these would be necessary in order to come to some conclusion as to what was the best element for our customers to use, taking into consideration both time and consumption of energy.

Mr. Mickler : I have given the set up, given all the particulars, all the details of how the tests were carried out, so if anyone wishes to conduct any further tests he can start with that ground work and go just as far as he likes. I brought this kettle along to show you that the so-called flat-bottomed kettle is not always flat bottomed, and to show you where the water went which I put on the element. You can see there is a space of from a sixteenth to a thirty-second of an inch, over half the bottom of that kettle, and this is the surface of a so-called flat element, which does not remain flat very long after it has been subjected to excessively high temperatures. A kettle with a bottom such as this is will more or less conform itself to the shape of the element, particularly if there is enough water in it to weight it down, but the last test I made shows how little contact there really is between the bottom of a flat-bottomed kettle and a flat element. Something should be done, either by the manufacturers of elements, or by the manufacturers of utensils, to ensure more perfect contact between the two.

Mr. W. R. Carr, Electrical News :

Do you suppose that is the best material for a tea kettle, or do you suppose that is the best shape ?

Mr. Mickler : I really believe the best type of kettle is one with a flat bottom, with a flange which would allow the kettle to fit over the sides of the element. But that is hardly practical, because nearly all range elements are a pretty snug fit in the top of the stove, and flush with it, and it would be difficult to make the kettle fit over the element. Furthermore, the flange would soon suffer damage by kinks and would be rendered useless as a flange. This (a flat bottomed kettle as illustrated) seems to me the most practical utensil.

Mr. Carr : There was the old-fashioned range, where the utensils came with the range, and clamped down over the element ; the Simplex, they called it.

Mr. Mickler : I think that too little attention is paid to the adaptibility of utensils for use on electric range elements. Not so much gas, where the contact is not the all-important thing. Of course, with open elements, you do not depend entirely on contact, but on radiation, and you do not require such a flat

bottomed utensil, where these are used.

Mr. C. E. Kirkby, Brantford Twp.: I wondered if Mr. Mickler had taken any tests on other than the copper kettle, such as an aluminum one. I believe that the aluminum utensils are more extravagant in their use of current, as they radiate heat. The other types of utensils are much more economical in my estimation.

Mr. Mickler: As I mentioned in the early part of this discussion, I did make tests on a previous occasion. I ran a series of tests in 1923, and I completed some, I think, in 1926, using a porcelain enamelled kettle. I secured this copper kettle, or one like it, and made comparisons of the results as between the porcelain and copper, and I found that the copper was 25 per cent. faster than the equivalent porcelain kettle; 25 per cent. faster on a closed element. I did not try it on an open element.

Wood products enter into the manufacture of commodities which touch every phase of human existence and fifty per cent of Canada's manufacturing industries depend on wood as a raw material. The capital invested in our forest industries is $666,000,000—one-third in lumbering plants, sawmills, etc., and practically all the remainder in the pulp and paper industry.—*Natural Resources, Canada.*

Association of Municipal Electrical Utilities

Minutes of Convention

THE twenty-first convention of the Association of Municipal Electrical Utilities was held at the Clifton Hotel, Niagara Falls, Ontario, on June 23rd, 24th and 25th, 1927.

The convention was opened at 9.30 a.m. on Thursday, June 23rd, with the President, Mr. J. J. Heeg, as chairman, who gave a short address welcoming the delegates and pointing out the objects of the convention.

Mr. E. M. Wood, Electrical Engineering Department, H.E.P.C. of Ontario, read a paper on "Grounding." Discussion following this paper was by Messrs. W. S. Borden, T. C. James, W. H. Mulligan, J. H. Caster, C. W. House, J. E. B. Phelps, E. V. Buchanan, and R. H. Starr.

Mr. H. D. Rothwell, Municipal Department, H.E.P.C. of Ontario, read a paper entitled "Power Billing Based on Demand." Discussion that followed was by Messrs. W. R. Catton, E. V. Buchanan, A. G. Grier, C. W. Baker, J. E. B. Phelps, F. T. Wyman, E. I. Sifton, J. H. Caster, and H. J. McTavish.

The session adjourned at 12 o'clock noon.

At 1.00 p.m. the delegates met with the Ontario Municipal Electrical Association for the first Convention Luncheon, which was presided over by Mr. C. A. Maguire, President, O. M. E. A. Mr. H. P. Stephens, Mayor of Niagara Falls, welcomed the delegates of both Associations to Niagara Falls, after which Mr. C. S.

Connolly, New York and Ontario Power Company, gave an address on the St. Lawrence Development.

At 6.30 p.m. the delegates of both Associations met for the Convention Dinner when Dr. Oskar Klotz, Professor of Pathology and Bacteriology, University of Toronto, as guest of the Associations, gave an address on "Research and Service."

The second session of the convention was called to order at 9.50 a.m. on Friday, June 24th.

Mr. Wills Maclachlan, Employees Relations Department, H.E.P.C. of Ontario, gave an address on "Accident Prevention."

Mr. A. K. Baylor, General Electric Company, New York, read a paper on "Opportunities and Duties of Electrical Utilities." Discussion following Mr. Baylor's paper was by Messrs. O. H. Scott and E. V. Buchanan.

The President read a report from the Rates Committee, reporting progress.

Mr. G. J. Mickler, Sales Department, H.E.P.C. of Ontario, read a paper on "Electric Range Elements." Discussion following this paper was by Messrs. J. N. Wilson, C. S. Barthe, F. Gover, E. V. Buchanan, W. R. Carr and C. E. Kirkby.

The session adjourned at 12 noon.

At 1.00 p.m. the delegates of the two Associations met for the second Convention Luncheon, which was presided over by Mr. J. J. Heeg, Rev. G. W. Tebbs, of Burlington, as Speaker, gave a humorous address.

The third session of the convention was called to order at 9.45 a.m., on Saturday, June 25th.

Mr. W. G. Hanna, Legal Department, H.E.P.C. of Ontario, read a paper entitled "Concerning some Contracts often Used." Discussion following Mr. Hanna's paper was by Messrs. D. B. McColl, J. A. Harris and W. Ellis.

The President then expressed his thanks and appreciation to those who had contributed to the success of the convention and asked Mr. W. K. Sanderson to take charge of the meeting, which now became a joint session of the Ontario Municipal Electrical Association with this Association.

Mr. T. J. Hannigan, Secretary O.M.E.A., presented three resolutions passed by the Executive of that Association to be re-affirmed, as follows :

A resolution in respect to the development of the St. Lawrence river, renewing and re-affirming the attitude of municipalities on several previous occasions and urging the Dominion Government to approve of the plans lodged with them three years ago by the Hydro-Electric Power Commission of Ontario for such development.

A resolution in respect to a memorial to the late Sir Adam Beck, urging upon the Government of Ontario the taking of steps towards erecting a suitable memorial in memory of him.

A resolution urging the Hydro-Electric Power Commission of Ontario to establish a Publicity Department to keep the municipalities and the people advised as to the progress of Hydro.

A resolution moving the re-affirmation of the foregoing was made by Mr. Hannigan, which on being seconded by Mr. Aug. Lang was carried.

Mr. Hannigan then presented a report of the work that had been done by the Joint Committee of the O.M.E.A., and A.M.E.U. on the Pension and Insurance Scheme for the Municipal Utility employees.

It was moved by Mr. P. W. Ellis and seconded by Mr. W. Ellis, That the Pension and Insurance Committee of the O.M.E.A. and A.M.E.U. be instructed and empowered to make the necessary arrangements to make it possible for the Municipal Commissions to take advantage of the recently secured enabling legislation, authorizing Pensions and Insurance for Municipal Hydro-Electric Systems. Carried.

It was moved by Mr. J. E. B. Phelps, That the present committee continue to act with the power to add to its number. This resolution, being duly seconded, was carried.

Mr. T. J. Hannigan, on behalf of the O.M.E.A., paid tribute to those who had made the convention the success it was.

Reference was made to the original members of the O.M.E.A. who were present at the convention, naming Messrs. W. K. Sanderson, T. J. Hannigan, W. Ellis, Aug. Lang, and P. W. Ellis, after which the proceedings were closed.

The register shows the total attendance at the convention to have been 347, classified as follows :

Class A	91
Class B	97
Commercial	82
Associates	43
Visitors	34

There were 303 present at the Convention Luncheon on the first day and 339 at the Convention Dinner. The attendance at the Convention Luncheon on the second day was 245.

Rates Committee Report

TO THE PRESIDENT AND MEMBERS OF THE A.M.E.U. :

Your Rates Committee beg to report that while we have not held a meeting since our last Convention in January, the views of the different members of this Committee on various phases of present rates have been obtained through correspondence.

At present, we have no recommendations to place before the Convention, but beg leave to report progress and, in all probability, we will have several suggestions to place before the members of this Association at our Winter Convention.

Respectfully submitted,

V. G. MCINTYRE,
Chairman.

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in July, 1927.

Appliances

AMERICAN BOSCH MAGNETO CORPORATION, Springfield, Mass.

Radio "B" Socket Power.

Marking: Trade Mark "Bosch Nobattry" marked on nameplate.

* * * *

THE BLACK & DECKER MFG. CO., LIMITED (Submittor), 10 St. Sophie Lane, Montreal, Que.

THE BLACK & DECKER MFG. CO. (Mfr.), Towson, Maryland.

Valve Refacer for use in grinding valves in automobile engines.

Marking: Mfrs. name and motor ratings.

* * * *

COMET RADIO PRODUCTS, 1284 St. Clair Avenue West, Toronto, Ont.

Rectifier, Portable battery charger. "Comet."

* * * *

DAY SIGN COMPANY, 124-128 Richmond St. W., Toronto, Ont.

Electrically-illuminated Display Signs.

* * * *

S. W. FARBER, INC., 141-151 South 5th St., Brooklyn, N.Y.

Therapeutic Lamps. "Adjusto-Ray". Nos. 15, 17, 19.

* * * *

FINDLAY BROS. CO. LIMITED, Carleton Place, Ont.

"Findlay" cabinet type electric cooking range. Style C.24S.

Hotplate attachment for coal ranges.

GLOBE MACHINERY CO., LIMITED, 100 Church St., Belleville, Ont

Portable Floor Surfacer. "Elliott."

* * * *

HAMILTON OVEN WORKS, 217 King St. E., Hamilton, Ont.

Electric Bake Ovens—550 V.

* * * *

HOUSE ELECTRIC HEATING CO. INC., 1061 Rue Bleury, Montreal, Que.

"Veronneau" Electric Air Heaters, radiator type. Types R and R2.

* * * *

LINDSTROM & COMPANY, 30 West Lake St., Chicago, Ill.

Portable high frequency generators "Elco". Models 17C, 34B and 38C.

* * * *

NATIONAL SEWING MACHINE CO., Belvidere, Ill.

Electric sewing machine. Model B.

* * * *

RADIANT ALUMINUM COMPANY, 22 Orillia St., Toronto, Ont.

Coffee Percolator.

* * * *

RADIO BRANCH, DEPARTMENT OF MARINE & FISHERIES, Ottawa, Ont.

Radio Appliances. Choke Coils. Types DW.22, DW.18, DW.14, DW. 12, DW.10, SW.22, SW.18, SW.14, SW. 12, SW.10.

* * * *

RONEO COMPANY OF CANADA LIMITED (Submittor), 50 King St. E., Toronto.

Roneo Company of Canada Limited (Mfr.), 5-11 Holborn St., London, E.C. 1, Eng.

Electrically-operated Duplicators and Roneotype.

* * * *

Triplex Electric Company, Limited, 126 Wellington St. W., Toronto, Ont.

Portable electric table stove. Cat. No. 100.

* * * *

*Chapman Electric Neutralizer Co. (Mfr.), 58 Fore St., Portland, Me.

United Printing Machinery Co. (Submittor), Jamaica Plain Station, Boston, Mass.

"Chapman" Static Neutralizer.

* * * *

*Chickering & Sons, 791 Tremont St., Boston, Mass.

Player Pianos.

* * * *

*Great Northern Mfg. Co., (Submittor), 536 Lake Shore Drive, Chicago, Ill.

"Quality Brand" Flat Iron. Cat. No. 2702.

* * * *

*Honeywell Heating Specialties Co., The, Wabash, Ind.

"Honeywell. Type A". Electrically-operated oil shut-off valve or oil shut-off and regulating valve.

* * * *

*Keystone Mfg. Co., 53 Wareham St., Boston, Mass.

"Moviegraph" Toy picture projecting machines. Models 147N, 193N, 261N, 572N.

* * * *

*Metal Ware Corporation, 111 W. Washington St., Chicago, Ill.

Percolators. Cat. Nos. S-56, S-61, S-63, S-64, S-68, 710, 711, 712, 714, 1600, 1601, 1602, 1800, 1801, 1802.

Toaster, Cat. No. S-59.

Waffle Iron, Cat. No. S-75.

Portable air heaters. "Empire" Cat. No. S-72; "Empco" Cat. No. 1809.

Marking: Nameplate with trade mark "Empire" or "Empco" and rating.

* * * *

*Monitor Furnace Co., The, 111 Woodrow St., Cincinnati, Ohio.

Mechanical Draft Oil Burner, Type A.

* * * *

*Valley Electric Company, 4515 Sahw Ave., St. Louis, Mo.

"Valley" Vibrating rectifiers. Type MC, AB, ABC, KA.

* * * *

*Webster Electric Co., Racine, Wis.

Power Transformers, core type (as listed on Underwriters' Laboratories card dated June 3, 1927).

* * * *

Fittings

Electric Sun Light Limited, 15a Notre Dame St. W., Montreal, Que.

Fixtures for concentrated illumination of interiors.

* * * *

Weiss & Biheller Inc., 69 East Adelaide St., Toronto.

"W & B" two and three-way current taps.

* * * *

*Globe Metal Mfg. Co., 2122-26 E. Hazzard St., Philadelphia, Pa.

Ground Clamps.

* * * *

*Monowatt Corporation, 546-48 Broadway, New York, N.Y.

Separable composition attachment plugs. Cat. Nos. 401, 600.

Marking: "Cetelite" or "C".

* * * *

*Rodale Manufacturing Co., Inc., 200 Hudson St., New York, N.Y.

Composition Attachment Plug, Cat. Nos. P-21, P-23.

Separable attachment plugs, Cat. Nos. P-26, P-48.

Attachment plug caps, Cat. Nos. P-20, P-27, P-39.

Marking: Rodale or letter R molded in face of plug.

* * * *

*Royal Electric Co. (Submittor), Chelsea Station, Boston, Mass.

Edison plug fuses. "Royal Crystal."

* * * *

Switches

Aluminum Goods Mfg. Co., Manitowoc, Wis.

Switch Box Plates. "Agmco."

Riley Engineering & Supply Co. Ltd., 360 Dufferin St., Toronto, Ont.

Hand-operated reversing switch, for cranes.

* * * *

Portable Lighting Devices

The De Vilbiss Mfg. Company, Limited, 225 Wellington Ave., Windsor, Ont.

Portable electric perfume lamps.

* * * *

The Thornton-Smith Company, Limited, 342 Yonge St., Toronto, Ont.

Portable electric lamps. "TS".

* * * *

Miscellaneous

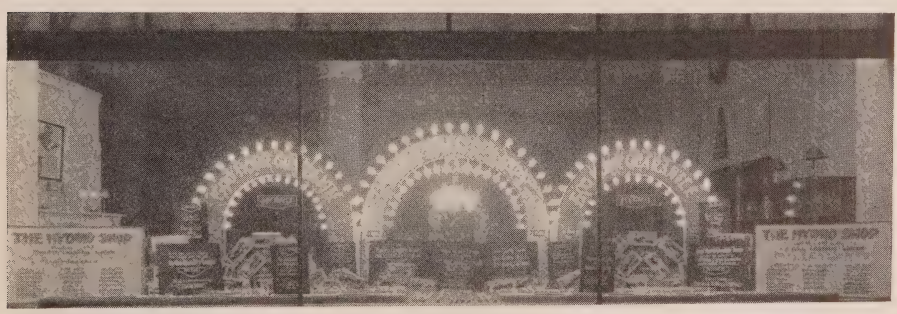
*Monarch Fuse Co., Inc., Jamestown, N.Y.

Edison plug fuses.

Cartridge enclosed fuse—renewable and non-renewable types "Monarch."

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.



Re Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.—*Editor*

THE

BULLETIN

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University of Toronto Centennial

WITHIN the next month there will be celebrated at the University of Toronto, the one hundredth anniversary of the founding of King's College, at Toronto, from which small beginning the University has grown. The proceedings are to extend from Thursday, October 6, to the afternoon of Sunday, October 9.

Concurrently, and as a part of this celebration, the School of Practical Science, now the Faculty of Applied Science and Engineering of the University of Toronto, will hold its semi-centennial.

This celebration has a particular significance to the Hydro-Electric Power Commission of Ontario, and helps to mark the year 1927 in its history. In building up its vast organization and system, the Commission has, to a very great extent, utilized men from Canadian Universities, a large proportion being University of Toronto graduates.

It is a fitting coincidence that the Centennial of the University of Toronto, the semi-centennial of the Engineering Faculty and the silver anniversary of the origin of the Hydro Electric Power Commission of Ontario, should all fall within the same year, 1927, as that marking the Diamond Jubilee of the Dominion of Canada.

We give in the following, the programme of the joint proceedings, as an effort in assisting the University of Toronto, to make the Centennial Celebration a success.

PROGRAMME

THURSDAY, OCTOBER 6TH.

9.00 a.m. to 11.00 a.m. Registration of Delegates.

All day — Registration of Graduates.*

11.00 a.m. — First Lecture on "Aspects of Canadian History since Confederation," by Hon. L. A. Taschereau, Prime Minister of

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September, 1927

	the Province of Quebec. Convocation Hall.
12.30 p.m.	Informal Luncheon for Delegates in Hart House. Informal Luncheon for "School" Alumni and Ladies at King Edward Hotel. Class Luncheons.
1.45 p.m.	Assembly of Board of Governors, Senate, Staff, Guests, Delegates and Graduates in Simcoe Hall, (Academic Robes).
2.00 p.m.	Procession from Simcoe Hall to Univ. Arena.
2.30 p.m.	Opening Ceremony and Reception of Delegates in the Arena.
5.00 p.m.	Dedication of the Carillon.
7.30 p.m.	Dinner to Guests, Delegates and Graduates in University Arena, (Formal).
8.00 p.m.	University College Alumni Smoker—Junior Common Room. University College Ladies' Bridge.
8.30 p.m.	Installation Ritual of the Calling of an Engineer in Convocation Hall.
10.00 p.m.	"School" Smoker.

FRIDAY, OCTOBER 7TH.

11.00 a.m.	Second Lecture on "Aspects of Canadian History since Confederation," by Hon. G. Howard Ferguson, Prime Minister of the Province of Ontario. Convocation Hall.
12.30 p.m.	Informal Luncheon for Delegates in Hart House, Class Luncheons.
2.30 p.m.	Inter-Faculty Track Meet in the Stadium.
2.45 p.m.	Conferring of Honorary Degrees in Convocation Hall.
3.30 p.m.	"School" Reception to Ladies at Granite Club.
6.30 p.m.	University College Graduates' Dinner—East and West Hall. Victoria College Alumni Dinner Burwash Hall. Victoria College Alumnae Dinner—Annesley Hall.
7.45 p.m.	"School" Dinner Dance—King Edward Hotel.
9.00 p.m.	Centenary Ball in Hart House.

SATURDAY, OCTOBER 8TH.

9.30 a.m.	Annual Meeting, Engineering Alumni Association — Mining Building.
10.00 a.m.	Re-union of Ontario College of Education Graduates. Pageant illustrating early education.
10.30 a.m.	Annual Meeting Alumni Federation, Hart House.
12.00 noon	Unveiling and Presentation of Dean Galbraith Memorial. Unveiling and Presentation of Portrait of Sir John Beverley Robinson.
12.30 p.m.	Informal Luncheon for Delegates in Hart House. Class Luncheons. Ontario College of Education Luncheon.
2.15 p.m.	Rugby Game, McGill vs. Varsity in the Stadium.
6.30 p.m.	Class Dinners.
7.30 p.m.	"School" Dinner at King Edward Hotel.

SUNDAY, OCTOBER 9TH.

3.00 p.m.	Divine Service in University Arena. Sermon by Rev. Dr. Cody. Music by the Mendelssohn Choir.

Lectures will be delivered each morning in the different Faculties and Colleges. Separate programme covering these will be issued at a later date.

* "School" Registration at King Edward Hotel, all others at University.

New Semi-Outdoor Station of the Windsor Hydro-Electric System

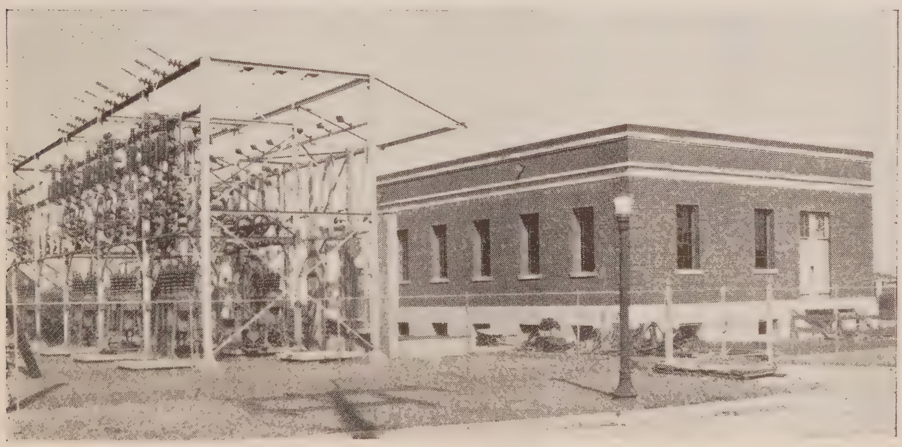
By H. V. Armstrong, Electrical Engineering Dept., H.E.P.C. of Ontario

THE Windsor Hydro-Electric System has recently completed and placed in operation a new semi-outdoor station to take care of the load in the southern part of the city, this station being situated at the corner of Hanna and Ellesmere Streets.

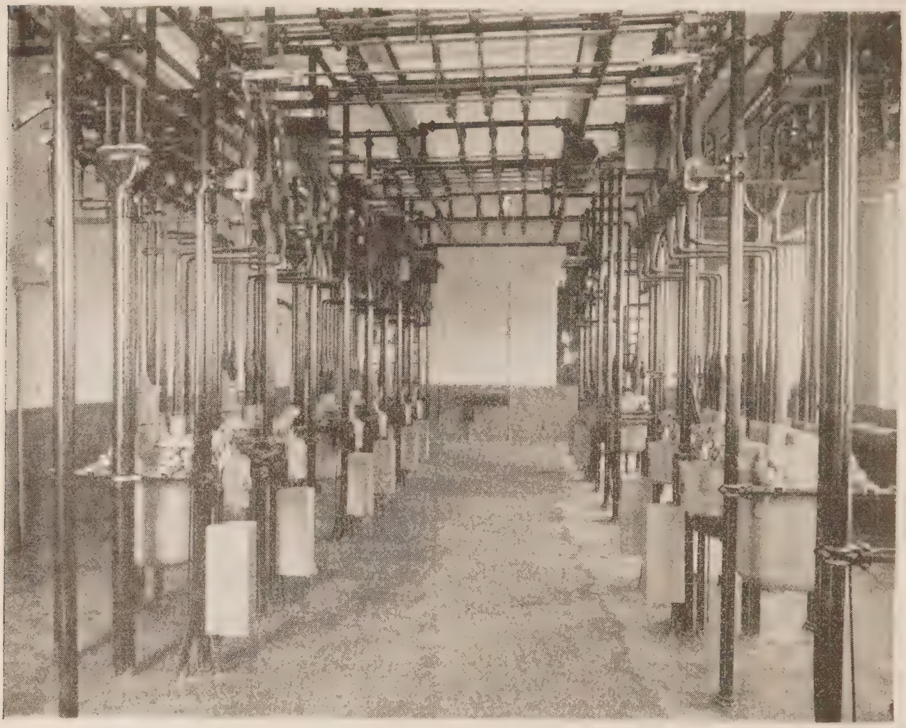
Early in 1926 plans and specifications were prepared for this new substation to accommodate four 26,400 volt lines, five 3,000 kv-a. 3 phase transformers, and fourteen 4,000 volt feeders, all to be operated through supervisory control apparatus from the Municipal Station No. 1 at McDougall Avenue, approximately 1¼ miles away.

High Voltage Structure and Equipment

The outdoor structure supplied and erected by Canadian Bridge Company is of fabricated steel, 75 feet long by 25 feet wide, divided into five bays, on which is mounted the 26,400 volt switching equipment for two incoming lines from Essex Transformer Station, one tie feeder between this station and McDougall Avenue Station, one outdoor feeder to the Ice Company, and two 3,000 kv-a. 3 phase outdoor transformers with provision made for an additional three 3,000 kv-a. 3 phase transformers. Each line and transformer feeder has its own automatic oil circuit breaker, current transformers and disconnecting switches. The 26,400 volt bus is made up of No. 4/0 stranded bare cable divided into three sections by disconnecting switches on each side of the centre bay. Connected to this centre section of the bus through disconnecting



26,400 Volt Outdoor Structure and Low Voltage Switch and Control Building.



4,000 Volt Switching.

switches and fuses are two 25,000/100 volt outdoor potential transformers.

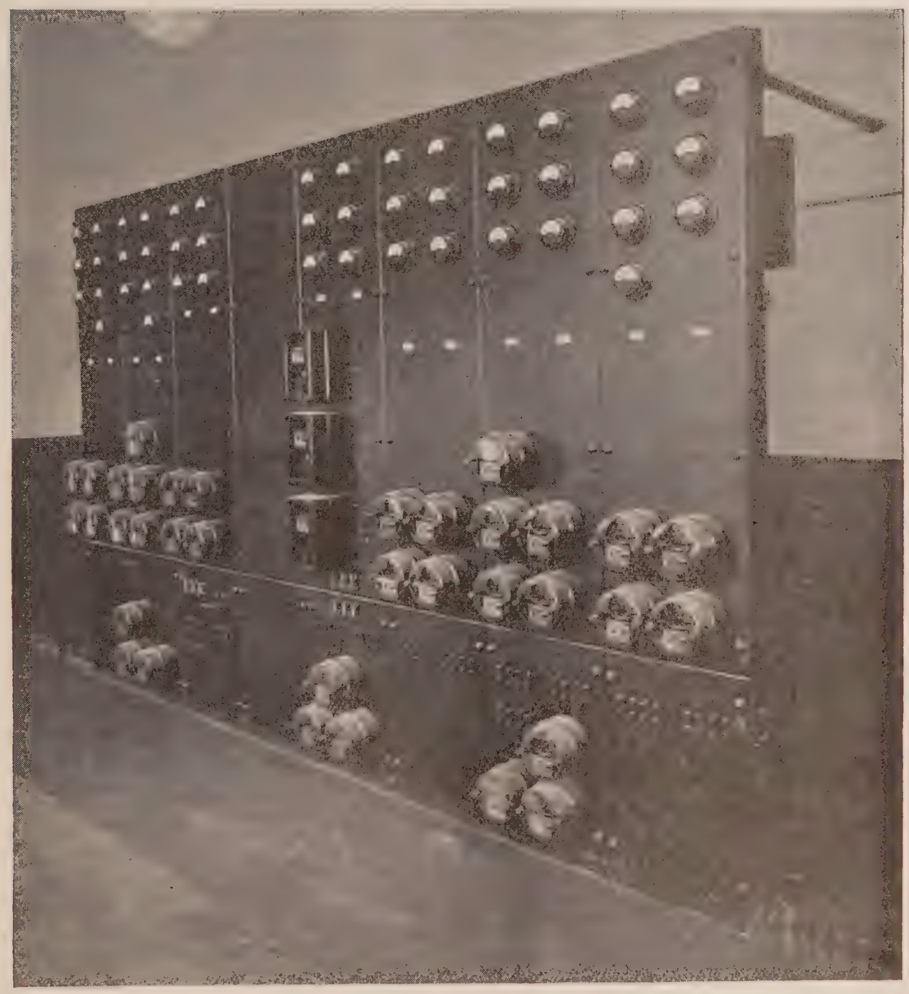
The transformers rated 3,000 kv-a. 3 phase, 25 cycle, 26,400-13,200/-2,300-4,000 volt O.I.S.C. outdoor radiator type were manufactured by the English Electric Company. The current transformers are the air insulated type and manufactured by the Production and Service Department of the Hydro Electric Power Commission. All the other equipment was manufactured by the Canadian Westinghouse Company. The installation of the outdoor equipment with the exception of placing the transformers on their foundation was carried out by the Canadian Westinghouse Company.

Low Voltage Building and Equipment.

Beside the outdoor structure is a one-storey brick building 52 ft. long, 43 ft. wide, and 16 ft. high, with a basement 12 ft. high, erected under contract by Muxlow & Gale. The exterior surface of the walls is of pressed brick, with cut stone trim while the interior is finished with cement plaster. Windows on all sides provide natural lighting and ventilation. The main floor is divided into three sections, one section 50 ft. long and 25 ft. wide is used for the 4000 volt switching equipment. Another section 31 ft. long and 15 ft. wide is used for the switchboard room and the third is used for the erection

room, provided with a $7\frac{1}{2}$ ton travelling chain block, a hatchway with removable cover and a stairway to basement. The basement is used for the battery room, station service transformers, motor generator set, and the feeder voltage regulators and their equipment.

All the 4,000 volt apparatus is mounted on pipe structure and laid out in two rows, the length of the room, with passage ways on each side and one in the centre. Over the centre passage is the main bus consisting of two 2 by $\frac{1}{4}$ in. bars sectionalized in five parts, with the emergency bus of one 2 by $\frac{1}{4}$ in. bar over each outside passage-way connected together at one end and sectionalized in four parts. In each



Meter and Relay Switchboard.

row provision is made for an ultimate installation of ten feeder equipments with the present installation of nine feeders in one row and four feeders in the other, made up of two transformers, three power, six lighting, one station service, and one bus tie. Each feeder is equipped with automatic oil breaker, current transformers, and two sets of disconnecting switches. Each lighting feeder has a 100 kv-a. 3 phase, 25 cycle, 4,000 volt feeder voltage regulator connected in the line through disconnecting switches and arranged so that it can be taken out of service with the least possible interruption to the service. Connections between the low side of the transformers and the oil breakers are made with single conductor lead covered cable laid in fibre duct. All feeders leave the building in 3 conductor lead covered cable in ducts.

In the switchboard room is installed a nine-panel switchboard on which are mounted the instruments and relays for controlling the low and high voltage feeders. On the rear of this board are the interposing relays used in connection with the supervisory control system for operating the breakers. In addition to the main board is a two-panel board for the battery and station service and the relay cabinet for the supervisory equipment.

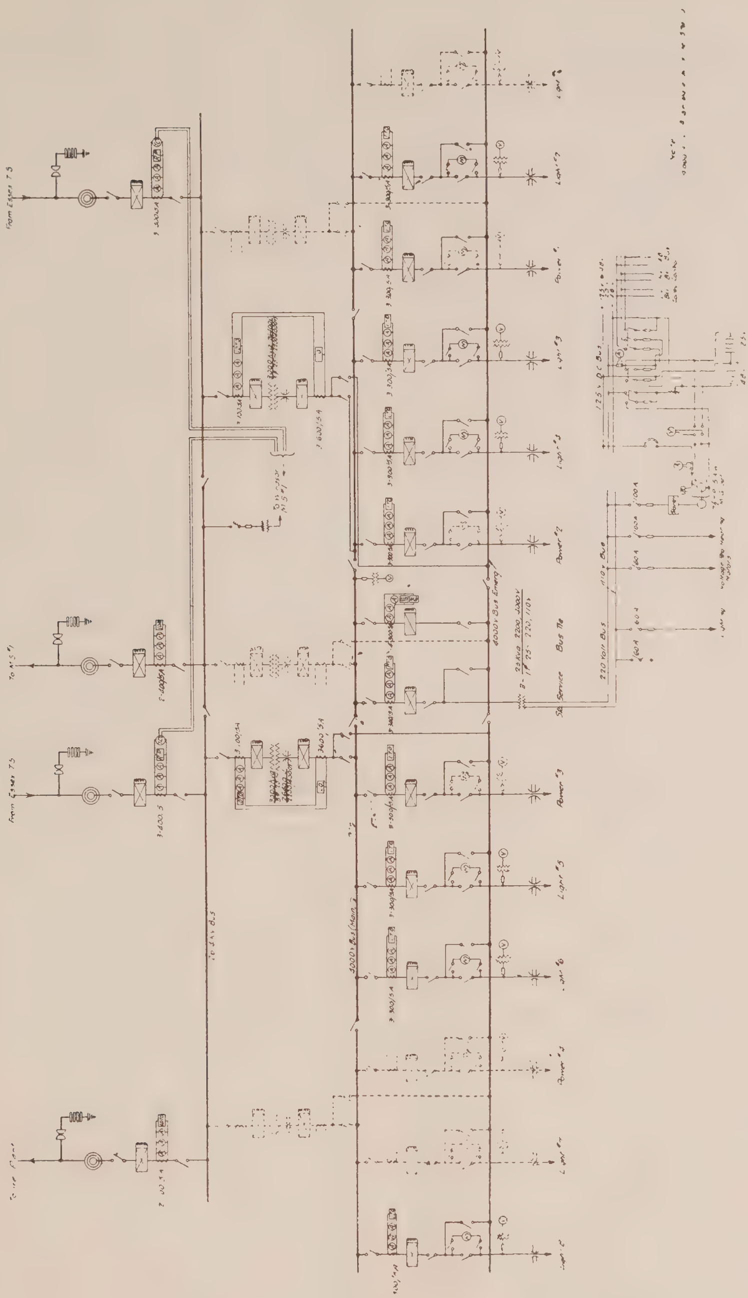
All the 4,000 volt equipment, including the switchboard, except the battery, motor generator set and service transformers, were manufactured and installed by the Canadian Westinghouse Company. The battery and motor generator set were manufactured by the Exide Battery Company and the Canadian General Electric Company respectively and installed by the local Commission.

The entire station is enclosed by a 6 ft. chain link fence with entrances provided to outdoor structure and building.

Operation

The operation is undertaken entirely from the McDougall Avenue Station by means of a synchronous visual type supervisory control equipment which consists of a dispatcher's control cabinet, relay cabinet and a synchronous motor operated clock in McDougall Avenue Station and a similar relay cabinet in this new station. The dispatcher's control cabinet, 18¾ in. by 25 ¾ in. by 10 in., is equipped with the necessary control keys and indicating lamps to control and supervise a total of thirty breakers (one of which is a dummy breaker). This cabinet is mounted on the operator's desk and a short distance away is the relay cabinet in which are mounted the driving, registering and signalling relays, which in turn operate in step with similar relays in this new station which are connected to the interposing relays (mounted on the rear of the main switchboard) which cause the operation of the "Trip" and "Close" contractors which in turn directly control the solenoid coils of the oil circuit breakers by which the breakers are closed or tripped.

A 48 volt storage battery at each station is supplied for the operation of the supervisory relays, but the tripping and closing coils of the



Wiring Diagram.

breakers are supplied with 110 volts d.c.

The synchronous motor operated clock has a momentary half hour contact which is used in connection with the dummy circuit breaker equipment for checking the operation of the supervisory control at half-hour intervals.

Strung overhead between the two stations is an eleven pair lead covered telephone cable which is used for the operation of the supervisory control, remote metering and private telephone. The supervisory wires are protected at each end by supervisory control protective equipment.

This supervisory equipment was supplied and installed by the Canadian Westinghouse Company.

Metering

To keep a close check on the loads for both stations, all totalized at McDougall Avenue Station, some method of remote metering was required, and after much consideration and having the experience of the remote totalizing metering equipment in operation at Toronto, the thermal converter method for remote metering was installed. This system consists of a Lincoln Meter Company thermal converter for each incoming 26,400 volt line in both stations with the two leads of each converter from the new station brought to McDougall Avenue where all the leads from the four converters are connected in series and then connected to a Leeds and Northrup graphic recording potentiometer, which records the total power supplied to the Windsor Hydro-Electric System. This system of totalizing the load was developed by the engineers of the Hydro Electric Power Commission of Ontario in co-operation with the Lincoln Meter Company.

The design of this station and the supervision of the installation has been in charge of the engineering staff of the Hydro-Electric Power Commission acting on behalf of the Windsor Hydro Electric System.

Relay Protection of the Queenston Generators

By T. R. Millar and J. C. Martin, Electrical Engineering Dept., H.E.P.C. of Ontario.

THE generators at the Queenston Generating Station of the Hydro-Electric Power Commission of Ontario are rated four at 45,000 kv-a., and five at 55,000 kv-a., 80 per cent. power-factor, 12,000 volt, 3 phase, and have a speed of 187½ revolutions per minute. Each phase of the generator winding is split into two halves with the leads of each half brought out of the generator frame at the terminal and neutral ends. The generators are connected through a non-automatic circuit-breaker, to their respective transformers and also pro-

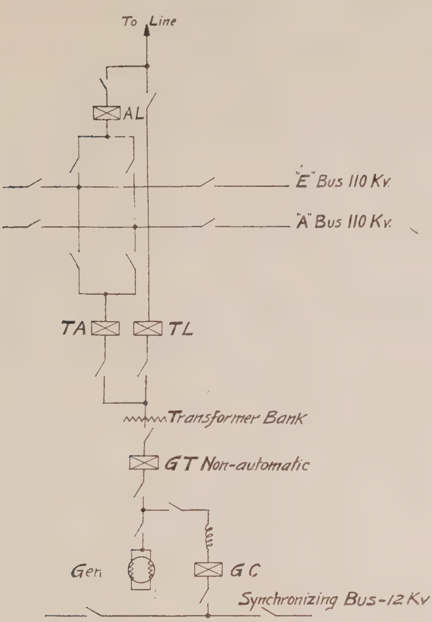


Fig. 2. Main wiring diagram for one unit, Queenston generating station.

vision is made to parallel them onto a 12 kv. synchronizing bus through an automatic circuit-breaker and reactor. No. 12 kv. power is delivered from the station.

The protection of the generators consists of a combination of differential current and split phase to operate on internal generator short-circuits and to open the necessary circuit-breakers to completely isolate the unit. The generators are operated with ungrounded neutrals.

The main diagram of connections for one of the units is shown in Fig. 1, and a schematic diagram of the generator windings with the current transformer and relay circuits is given in Fig. 2. Four bushing type current transformers for each phase are provided, one at each end of each half phase with their secondaries connected in a closed series circuit. Relays are connected to this circuit so as to trip on any unbalance of current among the four current transformers.

The operation of the protection will best be seen by referring to Figs. 3, 4 and 5, which show normal conditions and extreme cases of trouble and the corresponding response of the various relays. Fig. 3 shows the schematic diagram of onephase under normal load conditions. It is obvious that equal currents are flowing in the two halves of the winding; current will circulate in the current transformer circuits, but no current will pass through the Relays R_1, R_2, R_3.

Fig. 4 shows the condition of short-circuited coils within one of the parallel windings and represents the extreme condition of the entire winding being short-circuited. Under these conditions the current will flow as indicated. The current in the current transformers of one half winding will become reversed relative to the other half, and as a result current will flow in the split phase relay R_2.

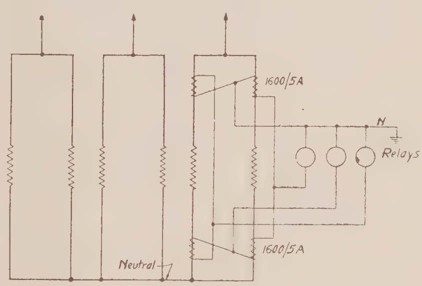


Fig. 2. Schematic diagram of generator windings with C.T.'s and relays connected in.

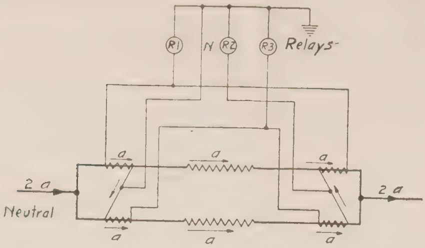


Fig. 3. Schematic diagram of one phase under normal conditions.

Fig. 5 represents the extreme condition of a short circuit between phases, one phase being grounded at the neutral end, and the other phase at the terminal end. It will be noticed that, depending on the location of the trouble, one or more of the relays will respond. With trouble towards the terminal end of the generator, relays R_2 and R_3 will respond (see phase 1), and in case of trouble towards the neutral, relay R_1 will respond (see phase 2).

This arrangement will cover practically all faults within the machine excepting single grounds. These are taken care of by means of a ground detector which operates an alarm and the defective machine is taken out of service by hand.

Nine (3 per phase) special low energy instantaneous current relays, requiring 0.64 volt amperes to trip, are used for each machine. Each relay is equipped with a by-pass saturating reactor to limit the voltage per relay to 30 volts under short-circuit conditions. The current transformers are 1,600/5 ampere bushing type and are capable of

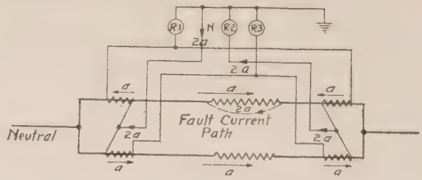


Fig. 4. Short-circuit of one of the parallel windings.

delivering a high volt ampere load without falling off in ratio.

Tripping of main circuit breakers, field circuit breaker, ventilating fan and air dampers is accomplished through the medium of a small contactor which furnishes tripping current to the unit trip bus and trips the annunciator drop. Current from this bus operates small contactors which trip all breakers and completely clear the generator.

The current transformer leads are wired to test link cabinets located near the generators to facilitate testing. From these cabinets the circuits are carried in conduit to the relay panels which are located in the control room.

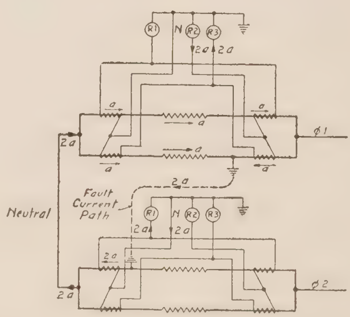


Fig. 5 Extreme conditions of short-circuit.

Accident Prevention

By Wills Maclachlan, Employees' Relations Dept., H.E.P.C. of Ontario.

(Address before Association of Municipal Electrical Utilities at Niagara Falls, June 24, 1927.)

IN making any statements in connection with accident prevention work, I wish it clearly understood that I am appearing before you personally. What I say, I do not wish you to connect with any policy of the Hydro-Electric Power Commission, but possibly more of my work in connection with the Electrical Employers' Association, an Association composed of about four hundred utilities in this Province, and our duty is to prevent accidents.

You might quite well ask me why it is worth while to prevent accidents? Last year, the industries of the province paid, in compensation to men, to doctors, hospitals, etc., about \$5,800,000. About half as much more is the cost to the men themselves, making a total cost of accidents in this province, industrial accidents, of about \$8,000,000. As a result of those accidents, you get no real return. What would \$8,000,000 yearly not do if we could save it? Your public utilities are carrying a burden in the cost of accidents of approximately \$100,000 a year; your men are going into their pockets to the tune of about \$50,000 in addition. For that \$150,000, you are getting no return. Surely, if you found that, in the operation of your plants, you were losing something in the neighborhood of \$150,000 a year, you would do something to try to save it. Now, that is one side of your accidents. There is another side. Go into any hospital at night and see what an accident means. Some of you have had the job that I have, of advising a family that the father or breadwinner had been seriously injured or killed, and you have some idea of what an accident means. But there is still another angle to it. After we get the man through the hospital and all cleared up in the best way possible, we have an after case to look after. A young man, a couple of years ago, made a mistake—some others made a mistake at the same time. He was a young lineman and I have got him cleared up and out of hospital but he has lost his right leg and left arm. He will get compensation for the rest of his life but how would you like to be put on the shelf at twenty-six, with nothing but a pension to look forward to? Now, those are some of the reasons why it is worth while to prevent accidents.

It's Up To You

Now, who can do it? They say, "Maclachlan comes around here and talks to our men, Mowat, Mulligan, and others. It is their job to prevent accidents." I have been at this work for twelve years; and you cannot pass the buck like that at all. You men are responsible for the

operation of your utilities. Safe operation is one of your jobs; and you are responsible for the accidents, whether you be chairman of a commission, a commissioner, a manager, a superintendent or a foreman. The responsibility for the prevention of accidents in your utility or in your gang rests upon you. I can go out and talk to your men. Others can go and talk to your men. But, unless you give the orders that the work shall be carried out in a certain way, our work will have absolutely no effect. Now, what do I mean by carrying out instructions? Take one thing alone. There is far too much working on 2,200 volts alive in this Province, and it is not necessary. There have been possibly five or six men killed within the last year in the province, unnecessarily, working on 2,200 volts alive. Take the smaller type of town. You have got one lineman. His job is to operate your utility. He goes ahead to do his work, and gets caught on 2,200 volts alive, and what happens?

A Concrete Case

I will give you a case. In a small town, a man went to do this work; he was caught on the top of a pole, on 2,200, clothing caught on fire, the people in the town got ladders, climbed the pole, took the keys of the sub-station out of his hip pocket, ran across the town, opened the sub-station door, tripped the switch and then went back and took the half-baked body off the pole. Is that operating a utility? And yet, I know, in that town, at the present time, they have an inexperienced lineman and there are no instructions that he should not work on 2,200 volts alive. In small towns of that type it is absolutely criminal to allow a man to work on or near the primary voltage.

Or, take your larger town. A great deal of your work can be done dead by using sectionalizing switches or branch cut-outs and cutting out certain parts at a time and working it dead. The International Nickel Company at Sudbury, having smelter loads, do not work on anything alive. If that can be carried out, then a great deal of your work can be carried out with safety. In the rural power districts of the Hydro-Electric Power Commission, work on 2,200 volts alive is absolutely prohibited, and the men have been so instructed; not only the foremen, but the men themselves. Even in your larger towns, where you have experienced men, work can only be safely carried out on 2,200 or 4,000 volts, when you have two men present, equipped with spurs and belts and the necessary rubber protection for the wires; and when you are putting on the rubber protection, for heaven's sake, don't forget your ground wires. They are just as important to protect. They are the other side of the circuit, just as much as your phase wires are the other side of the circuit and should be adquately protected.

Equipment

Now, in connection with your tools and your equipment for your men, one of the larger utilities in the Province—I am speaking of the

Windsor Hydro-Electric System—two years ago, grasped the idea that the belt is as much a piece of the equipment of the utility as the pole, or the wires, or the sub-station. They bought belts for their men and put them in place of the men's belts. If Mr. Perry, or Mr. Hubball were here, they would tell you that it has worked out perfectly satisfactory, and they would not go back to the arrangement of the men owning their belts. Then, when you have your tools and equipment in good shape, ask for decent maintenance and at least a monthly inspection—not by the man who is handling the tools, but by the foreman—to see that those tools and equipment are in good shape. That is a point you need to stress—that the line tools, whether they be spurs or belt or something else of that character, are just as much a part of your equipment as your poles, wires or sub-stations, and the maintenance of them is important.

I have heard the objection, "But, if we own the belt and the man falls, we are responsible." You cannot be made any more responsible than you are at the present time. You pay the whole cost of the accident now. You will pay it if you own the belt. You are not relieved, in the slightest degree, of your responsibilities.

Good Construction

Now, in connection with construction: I find a great deal of sub-standard construction in the Province. I do not say that the standards of the Hydro-Electric Power Commission are necessarily ideal. They are being modified and possibly, after years, they will become ideal, but they are about the best possible at the present time. And don't put up a transformer as if it was thrown on the pole (and there are a lot put up that way in the small towns, and in the big ones). When you are putting up a transformer just remember you may, or your men may, meet trouble on a dirty, sleety night next February or March, and give your men a chance to carry out their work with a reasonable degree of safety.

In connection with training in resuscitation—it is extremely important. Where we have men well trained, they certainly do everything that is possible to save the life, if a man gets a shock. I know that we cannot bring back every case that gets an electrical shock. You cannot save every life that gets pneumonia, or a number of other diseases. But we do know that a gang well trained in resuscitation will do everything in their power to save a life. Some of you have heard, or read some of the details, in connection with an accident that happened on the 20th of May in Sarnia. A young lineman was working on a cross-arm, working over the cross-arm instead of below it, untying No. 6, tying in No. 2. He brought his head in contact with 26,400 volts, fell unconscious in his belt, was lowered down from the pole and resuscitation started. That was two o'clock in the afternoon. A doctor was called and a hypodermic given, the man taken to the hospital, resuscitation being carried out. They

carried on resuscitation all that afternoon, brought in another gang during the evening, and by ten o'clock that night the doctor was satisfied the man was breathing normally—eight hours solid resuscitation to success—the longest case on record either in America or in Europe.

That is what a well-trained gang can do. I know full well there are other conditions, under which a man cannot be brought back with our present knowledge. We are going ahead to try and find out, if possible, what can be done.

Now, just to bring the points out. Give me decent construction, a clean transformer pole and a clean buck-arm pole, and particularly, give me well-trained men in carrying out their work—and I am not talking of telephone linemen allowed to work on power lines, and I am not talking of men working with the cross-arm at their waist and leaning over their wires—those are not well-trained men. Give me decent tools and equipment on the job, well-maintained and a reasonable degree of discipline carried out, and the man in charge, whether he be a foreman or a manager or Chairman of the Commission putting a real punch back of this to really put accident prevention over, then we will prevent accidents.

Resusciation at Sarnia

A report comes from Sarnia of a successful resuscitation which was performed on the morning of Thursday, August 25th, 1927. A railway employee at the Sarnia Tunnel Round-house was working on the top of one of the tunnel electric locomotives in the repairing department of the round-house and received a shock of around 3,300-volts.

This accident happened shortly after 9 o'clock in the morning when a call for help was phoned to the office of the Sarnia Hydro-Electric System, who relayed the message to the Hydro St. Clair station and to the Sarnia Rural Hydro office, all of which sent assistance which arrived at about the same time. At the scene of the accident they found Dr. C. Carruthers giving the man resuscitation but immediately relieved him and took charge of the work from that time on.

At the time of the arrival of the Hydro employees the man showed signs of life and it took 3 or 4 men to hold him down, as he was struggling very badly. Resuscitation was continued and later the man was placed in an ambulance and taken to Sarnia General Hospital, all of the Hydro employees proceeding to the hospital, two of them riding in the ambulance, and resuscitation continued until about 12.30 o'clock.

The patient has since been taken to his home and has, in less than two weeks' time, made sufficient recovery to permit his going around.

Correction

In the July *Bulletin*, page 249, second column, third paragraph, the word "growth" should be "cost." The portion of the sentence in which this occurs will, therefore, read—"cost in any case will gradually be reduced."

Protection of Telephone Lines

By W. B. Buchanan, Assistant Laboratory Engineer, H.E.P.C. of Ontario.

(Read before Western Counties Telephone Association at London, June 28, 1927.)

WE have been requested to present an outline of the technical features involved in the protection of telephone lines from serious hazards due to lightning and other extraneous high voltages. This problem is closely allied with power circuit protection because in many cases the energy liberated by a lightning discharge will be much greater than that picked up from a 2,200-volt line before the service is interrupted and the equipment for protection should conform to the same general principles of operation. In one respect telephone protection is more simple because no hazard is involved in dead-grounding the line whereas with the power circuit this is not permissible.

Discussing the problem from a broad point of view it is evident that any satisfactory scheme of protection must provide for abnormal currents at low voltages or abnormal voltages which may or may not be followed by heavy rushes of current. The first is provided against by suitable fusing, such fuses being capable of opening circuits up to 2,200 volts without damage to any other equipment or ejecting fire. Excess voltages may be drained off to ground without damage by suitable spark-gaps and good grounding connections, and apparatus protected where necessary by the use of insulating transformers.

Thus far the problem of telephone protection is identical with that dealing with heavy powered circuits but the question of cost of equipment and space requirements per circuit places them in different categories. The revenue per circuit and the cost or inconvenience of outages are also on a different scale, nevertheless the same physical laws underlie the operation of the equipment and similar methods of investigation and testing can be applied and an understanding of the technical features of apparatus used on both types of system is necessary to ensure successful co-ordination of the systems.

The Hydro-Electric Power Commission finds the operating requirements of its system demand first-class communication service between remote points and for this purpose maintains:

Two short-wave broadcast radio stations operating daily between Toronto and Nipigon.

Eight broadcasting stations for emergency operation on the Niagara System at 960–1,570 meters.

Sixteen guided carrier-wave telephone transmitting and receiving sets serving 540 miles of 110,000-volt lines and 3,000 miles of metallic telephone circuit giving continuous service.

Of the latter 146 miles are carried on the same poles as 110,000-volt power lines; 170 miles on poles carrying 44,000 volts; 32 miles on the 38 kv. line poles and in all over 2,200 miles of telephone circuits are carried on poles which carry power at or above 12,000 volts. In spite of the apparent hazards involved our operating engineers feel that adequate protection is maintained. The system used will be outlined later.

A fully designed service to a telephone subscriber requires from the line:

(a) Full 2,200-volt line insulation (if there be danger of this voltage) to a well-grounded horn-gap set for, say, 600 volts.

(b) A horn-gap or other type of arrester having high speed and a heavy discharge capacity to a well-grounded conductor at least equal in carrying capacity to the line.

(c) Fuses of small capacity, i.e., low enough to protect the telephone circuits, mounted on non-combustible base and capable of opening 2,200 volts or higher.

(d) A second horn-gap or arrester with lower setting than (b).

(e) Choke-coils placed in inductive relation to currents coming in simultaneously from the line but non-inductive to telephone currents.

(f) Repeating transformers with high-voltage insulation and grounded mid-tap on the line side.

(g) Spark gaps from the secondary or telephone side of the transformer to ground.

(h) A fuse (or heat-coil having time-lag) to protect receivers, etc., from continuous overload.

(i) A device for minimizing acoustic shocks on the ears of the operators.

Apparatus is available with which all the above functions can be fulfilled and the hazard to operators or from fire rendered negligible even when the line becomes alive at 2,200 volts. In the most of cases, however, much less than that listed is used and found satisfactory and in many cases without doubt less than is desirable is used for reasons of economy. In other cases such as where two or four-party selective ringing is desired the addition of repeating transformers adds complications that telephone engineers prefer to avoid. Telephone equipment which is located in close proximity to high tension lines may be affected appreciably by high voltages and circulating currents without actually coming into contact with the power circuit but by induction in the same manner as cross-talk occurs between parallel telephone circuits. Hence a standard of construction which might be quite satisfactory in an isolated district would be substandard and decidedly unsatisfactory in an urban district. The use of cabled conductors having a limited amount of insulation also places a limit on the voltage that may be permitted to exist between conductors or from conductors to ground.

These factors and many others must be taken into account in the selection of apparatus which may be considered satisfactory for protection in any given case. Obviously, the number of factors involved and the varying magnitude of each in different cases is such that only a careful

technical analysis of each particular case affords a solution which can be permanently satisfactory.

H. E. P. C. Standard Equipment on High Voltage Lines

The essential parts of this apparatus from each wire of the two-wire line circuit in to the receiver includes a horn-gap to ground, a switch, a fuse, a second horn-gap, a double choke coil non-inductive to telephone currents, a repeating transformer with grounded mid-tap on the primary, the secondary leading directly to the receiver.

For convenience in operation and testing, the switch on the incoming lines is made double throw, the reverse position connecting the line through a special bus which may be connected to either a spare receiver or test set.

The effectiveness of this equipment is shown in one case in a special test made between two power stations about four miles apart. Tests were being made on the station ground resistances by passing about eighty amperes into the ground at one station and bringing it back from the other station by way of the overhead power line. During the test it was noted that the compound was dripping from the telephone transformers which were apparently quite warm though no disturbance whatever could be detected in the telephone receivers. An ammeter inserted in the ground lead from the mid-tap read seven amperes. This illustrates a phenomenon of power circuit conditions, viz., the establishment of high ground potentials at the station due to fault current, that requires special consideration and may in some cases be a dominating factor.

Within the last few months an extensive series of tests were made in our Laboratories with the advice and assistance of engineers of the Bell Telephone Company to determine the ability of various pieces of equipment to perform the duty for which they were designed.

Two types of circuit were used to supply power of a destructive magnitude. One supplied up to fifty amperes at various voltages from 2,200 up to 6,600 volts; the other supplied surges of steep wave front with voltages up to 4,400 volts from a model lightning generator. The purpose of the former was to determine the maximum current carrying capacity of the various parts and that of the latter to check the responsiveness at high frequency of the various spark-gaps used in their proper places in circuit.

The type of circuit protection tested did not include the insulating transformer but simulated the entrance of an overhead line into and through sections of cable and protected by spark-gaps.

No radical changes in protective equipment have been suggested as the result of these tests, but assurance has been obtained that under given conditions apparatus now available can be depended on. Some spark-gaps operated consistently at voltages 300 to 350 volts, others about 800 volts. Standard telephone fuses opened the circuits on the heaviest power used, though in some cases the cartridge was shattered.

After opening the circuit the voltage necessary to restart an arc across the terminals of the fuse was found to vary from 5,000 to 45,000 volts.

Spark-gaps for low voltages depend on air as an insulating medium because it is self-restoring and cheap. Many gaps use perforated sheets of mica as spacers between carbon blocks. From a theoretical point of view the flat plate permits very prompt response to breakdown on overvoltage and on test this type will take care of a large number of impulses without developing a permanent short to ground. A power arc, however, may develop a permanent short to ground and necessitate cleaning of the carbon and possibly replacement of the mica. It is doubtful if any delicate detector would be entirely suitable to go back into service after having been subjected to the ground current from a power line and such gaps should be inspected when fuses have to be replaced. Some types such as those with the saw-toothed terminal may be more inherently self-clearing than others but if fusing takes place at all the spacing and hence the protective value of the gap may be affected quite seriously.

While reading over the reports of some of your meetings and the discussion following, I was impressed with the soundness of the recommendations made and it seemed very difficult to touch on any phase of the subject but what had already been very well treated at some time. There is one feature, however, that will bear repetition over and over again and that is the necessity of obtaining low ground resistance and ensuring their permanence. Suppose a rod ground has a resistance of 100 ohms and current of eight amperes flows into the ground, the line potential will actually be 800 volts above that of the territory one hundred feet or more distant and the hazards to personnel and equipment will be quite high. Suppose on the other hand you have a cross-over with some high voltage line and you install a spark-gap to ground on each side of the cross-over with fuses between the power line and spark-gap. Suppose the power line falls, the gap breaks down at something less than 500 volts, ground resistance may be made less than 25 ohms generally without much trouble or expense and 20 amperes flowing into this will not cause an excessive voltage but will blow one fuse in a few seconds without further damage. This disturbance should not cause trouble at all one-half mile away beyond interruption of the circuit at the point of cross-over.

An additional reason for low ground resistance in such a location arises from the fact that if contact be made between the power line and telephone lines so that several fuses are paralleled they may carry much more than the 20 amperes for an appreciable time. The chance may be remote but it is possible and the fuses must then either be opened in parallel or by cascading, which latter only allows a very short time for opening to each fuse and hence also requires heavy current.

One other practice I might mention is that of providing guard wires over-

head. There does not seem to be much to be said in their favor if care is taken to have the proper grade of materials in line construction to ensure ample mechanical strength. If deterioration takes place in the power line for any reason whatever that may make it hazardous to the users of the telephone service our maintenance department should be advised as promptly as possible. Power lines are built with the intention of staying up until taken down and the best of engineering available is applied to make them do so. In spite of all we can do we are occasionally treated to some uninvited thrills and we aim to make these as few as possible.

The Department of the H.E.P.C., with which I am connected, is especially interested in testing and devising ways of determining the suitability of equipment of many types and for many purposes. We can give protective apparatus such as you are interested in more actual duty and under known conditions in a couple of hours than it would get normally in an entire season and if the facilities of our Laboratories can be used to assist in the improvement of the conditions under which you operate, we would be very glad to co-operate as far as possible to do so.

Some Light on Lamp Light Testing

By G. G. Cousins, Illuminating Laboratory, H.E.P.C. of Ont.

THE production of manufactured articles of good quality calls for accurate control of the grade of materials entering into the manufacture and also of the various operations throughout the process of manufacture. Some kinds of manufactured goods can be rated as to their ability to fulfil their designed purposes by a careful inspection of the finished product backed by a knowledge of the grade of material and its supervision during manufacture. The ultimate buyer of a product is in very few cases able to properly judge the quality of goods, as it is well known that two brands of similar goods may be equally good as far as appearances can reveal and yet be vastly different in the inherent quality upon which satisfactory service depends. Some kinds of articles can be very adequately rated in quality by tests that do not affect the continued service ability of the articles tested and others require tests that result in the destruction of the articles tested. In the latter case the manufacturer or purchaser must rely upon the quality of the material and its control during manufacture to assure himself that the articles tested fairly represent the general quality of the goods from which the test samples were selected.

Incandescent electrical lamps are outstanding examples of the latter type of goods. Lamps are the most commonly and universally used of all electrical appliances, but because of

their cheapness and the simplicity of their construction they fail to command the respect that is their due, in view of the very important place they occupy in modern life and the great degree of accuracy required in their manufacture and testing. As a result the price is often the deciding factor in the purchase of lamps regardless of whether or not the lamp may produce illumination economically.

The purpose of lamps is, of course, to produce light, and the criterion by which lamp quality is judged is based upon the cost of producing light which includes the cost of the lamps and the cost of the power that they consume. It is impossible to judge lamp quality without a knowledge of the life performance of the lamps. This should include information on the following features : The average life of the group, the average initial efficiency, the average efficiency during life, and the average lumens during life. This information cannot be obtained without proper instruments and the means to carefully control the conditions under which the lamps operate during the periods of burning.

The initial efficiency and the life can be adjusted, each at the sacrifice of the other according to well established laws of lamp operation. If the initial efficiency is high the lamp gives more light for the power it consumes, but does not last as long as if the efficiency were lower. A lamp that burns at a very high efficiency may be too expensive because the cost of lamp renewals will be excessive. On the other hand, a lamp that burns at a very low efficiency may also be too expensive because too much power is consumed for the amount of light produced. The proper selection of efficiency with its related life is based upon a balancing of the lamp cost and the power cost, so that each is a minimum for the amount of light produced. There may be situations where these factors are not of much importance, but in industry and commerce and all places where business of any kind is carried on these factors are very important.

It is possible with low grade material and poor equipment to make lamps that will burn for very long lives by making them with very low initial efficiencies, but the amount of light produced would be relatively low. In using such lamps a purchaser may only obtain the equivalent in light of a 75 watt lamp while paying for the equivalent of a 100 watt lamp in power. It is obvious that the purchase of such lamps is false economy, but this is being done. Only high grade lamps will produce long life with high efficiency.

Incandescent lamps are simple in mechanical construction, but the manufacture and testing are complicated by the peculiar laws under which the filaments operate. The type of lamps with which most of us are concerned are for multiple burning on constant voltage circuits, and it is common practice to consider voltage as the controlling factor and to plot the characteristics against the voltage. The curves of Fig. 1 show the chief characteristics as related to the voltage. Notice particularly the very large change in life that a small change in voltage causes. It is convenient to remember that a 5 per cent.

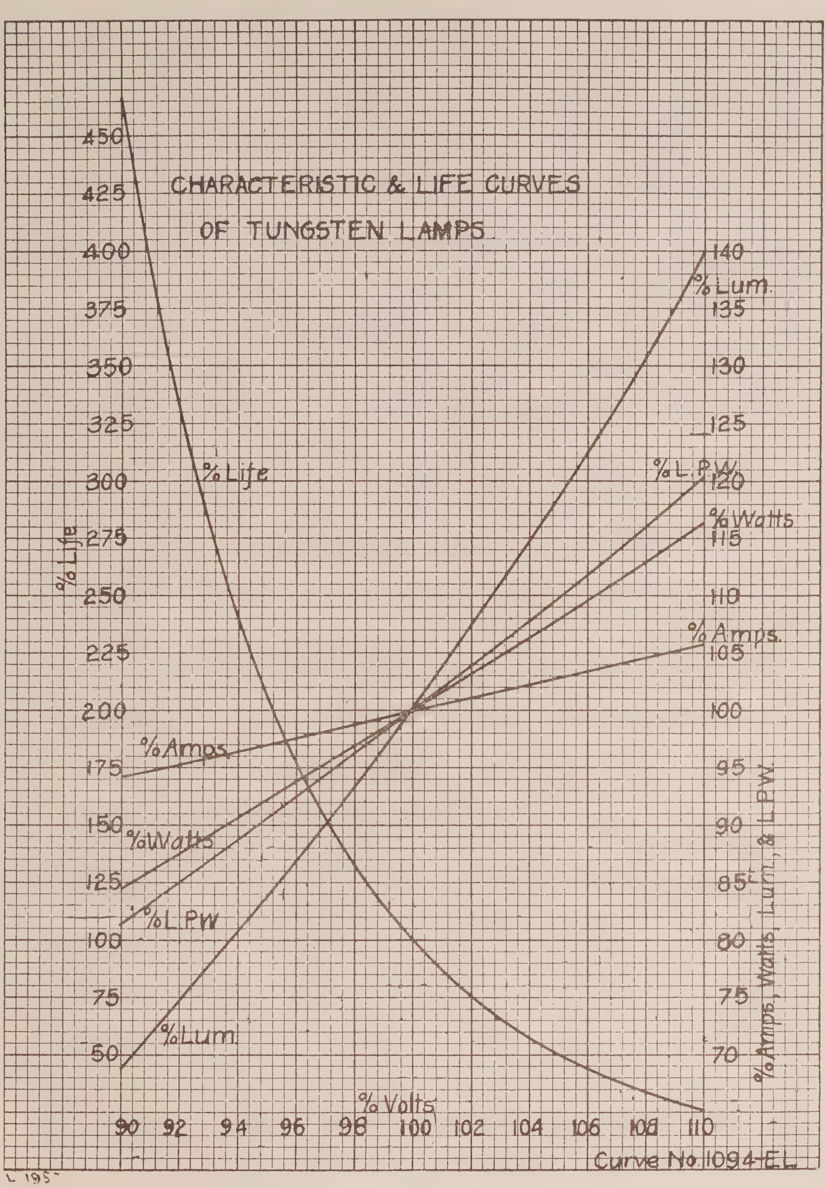


Fig. 1

increase in voltage decreases the life 50 per cent. This means that a 120 volt lamp burning at 126 volts would only have half its rated life. This emphasizes the importance of close voltage regulation and of having lamps of correct voltage rating for the circuits upon which they will be

used. The variation of life with voltage is the most important from the users view, and is unfortunately the greatest in magnitude of all the characteristics related to voltage. It is evident from this that the so-called service test under ordinary circuit voltage variations may be expected to be greatly in error and probably lead to erroneous conclusions.

Owing to unavoidable variations in the manufacture of lamps it is impossible for all lamps of a batch to be the same in rating or life performance, and as a result every care should be taken in the selection of samples of life test to select lamps that represent average quality as far as other tests and inspection can reveal. In spite of this, it is necessary to make allowance for possible deviations from the true average life of a batch of lamps in proportion to the number of lamps in the life test group. The magnitude of this allowance is shown by Table 1. This allowance is based upon experience gained from life testing lamps over long periods of time. It is included here to indicate the necessity for using caution in the interpretation of life test results. We have been frequently asked to make life tests of two or three lamps, a test which would not be worth the expense of making. A test of a very few lamps taken by itself is of rather doubtful value unless backed by a knowledge of the conditions and supervision under which they were manufactured.

The importance of the mean efficiency during life is recognized by the provisions in standard specifications for correcting the test life from the determined number of hours with

TABLE 1—LIFE TOLERANCES

Number of Lamps in Life Test Quantity	*Allowable per cent. Variation from Guaranteed Life	Number of Lamps in Life Test Quantity	*Allowable per cent. Variation from Guaranteed Life
5	25	16 or 17	14
6	23	18 or 19	13
7	21	20 to 24	12
8	20	25 to 29	11
9	19	30 to 34	10
10	18	35 to 44	9
11	17	45 to 54	8
12 to 13	16	55 to 99	7
14 or 15	15	100 to 249	6
		250 or more	5

NOTE.—The allowable percentages vary with the number of lamps in the life test quantity because, owing to unavoidable variations in individual lamps, the smaller the number the less accurately do the results represent the true average of the lamps represented.

a mean efficiency during that time to the equivalent number of hours based upon a stated mean efficiency. The reason for this may be explained as follows : Lamps that only depreciate 8 per cent. in efficiency during life will produce more units of light (lumen-hours) than similar lamps that depreciate more than 8 per cent. during the same time or will produce the same quantity of light in less time. It is thus evident that efficiency maintenance during life higher than the stipulated value has a real value that will compensate for a limited shortage in actual life. This compensation is accomplished as follows : Assume that for a group of lamps the rated life is 1,500 hours and the required average efficiency during life is 15 lumens per watt. Since the relation between life and efficiency is well established it is possible, when the life and mean efficiency during life of a test are known to calculate what the life would have been at some other efficiency. Thus, if for the group of lamps just mentioned the mean efficiency during life was found to be 15.3 lumens per watt instead of 15.0 and the average life was 1,330 hours, these lamps would just be the equivalent of 1,500 hours with a mean efficiency of 15 lumens per watt. This method of evaluating lamp life on the basis of the mean efficiency during life is considered a much better measure of the true lamp quality than the older method of basing the life upon the initial efficiency. It is an encouragement to the manufacturer to strive toward the ideal—the production of lamps that will outlast their designed lives with no depreciation in efficiency. Great improvements have been made in this direction in recent years.

In this brief article an attempt has been made to point out some of the more important features of lamp operation and the significance of information derived from life tests. It is not possible for the ordinary user of lamps to properly evaluate the merits of different brands of lamps from the behaviour of lamps in ordinary service. The variability of the most important factor, the voltage of the circuit, precludes the possibility of a reliable estimate of the length of life and the absence of means to determine what is being obtained from lamps prevents the user from knowing whether or not he is deriving reasonable service from the lamps he buys. Neither the length of life nor the efficiency nor the price in itself is any indication of lamp quality. The specifications provide information as to what may be expected from high grade lamps and a policy of supervision and testing is the most reliable guarantee of a high grade product.

Floodlighting of the New Eastern Entrance of the Canadian National Exhibition

By J. W. Bateman, Illuminating Engineer, Canadian General Electric Company, Limited

THE new Eastern Entrance of the Canadian National Exhibition, which was completed for the opening of the Exhibition this year, is a magnificent structure of a modified Roman type of architecture. Marking the eastern boundary of the Exhibition Grounds, it has been erected facing east along Fleet Street at the junction of Fleet Street and Strachan Avenue, and in this location can be very favorably viewed by the many people who travel along this new Lake Shore Boulevard.

The structure itself, being constructed of light-grey artificial stone, and located amid comparatively dark surroundings, remote from other buildings or attractions, presents a very favorable subject for floodlighting. By means of this new art, the gateway has been made more imposing and impressive by night than by day.

The gateway was designed by Messrs. Chapman and Oxley, Architects, and some conception of its size can be gained by noting that the over-all length is about 330 feet, and the central figure reaches to a height of about 85 feet above the ground. It consists of a main centre arch with colonades on each side, surmounted by a row of Canadian flags and Union Jacks, and finished with heavy masonry pylons at the ends, with fountains in front of each. The gateway serves to commemorate Confederation, the figures on the arch and pylons being symbolic of Canada's industries, while the main central figure showing a goddess with torch and crown of laurel, symbolizes Canada's Diamond Jubilee.

The floodlighting equipment, which was supplied by the Canadian General Electric Company, Limited, consists of fifty-1000 watt floodlighting projectors. To illuminate the front, there are two banks of seven projectors each, and two banks of nine each, located on the islands in front of the entrance. Two projectors in the two central banks have been directed upward to illuminate the two large banners on the flag-poles. The back of the gateway is flooded by light from two banks of nine units each, located along the boulevard. The combined beam candle-power of the floodlighting installation is 3,375,000 candles.

The projectors employed are G.E. Form L-15, each consisting of a galvanized sheet metal housing with a deep composite silvered and coppered glass reflector. They are equipped with a universal ball and socket focusing mechanism which permits adjusting in any direction, and employ the 1000 watt Mazda General Service Lamp. The front glass doors are equipped with lightly stippled lenses which soften the light and eliminate variations in the beams.

The interior of the main archway which is 25 feet wide and 40 feet high, is illuminated in amber color by means of sixteen 200 watt lamps in a mirrored glass trough, with Holophane reflector plates and color screens along each side. Some amber color is also added to the fountains by immersing in the water fifteen 150 watt amber colored lamps in Holophane vapor-proof units, in each fountain.

The Use of Electricity in Ontario Homes

By G. J. Mickler, Sales Dept., H.E.P.C. of Ontario

THE progress which has been made in spreading the use of electricity into the homes of Ontario can best be illustrated by the growth in the number of appliances in use. An increase in the number of kilowatt hours used by the average domestic customer does not necessarily mean that more electrical appliances are being used. It may signify longer hours of use of existing appliances.

There has been a steady growth in the number of kilowatt hours used on the average by domestic customers, such consumption increasing from 21.0 kilowatt hours in 1914 to 98.4 kilowatt hours in 1926, and this steady increase is due in a very large measure to the increase in the number of electrical appliances in use and the enlargement of the field of use.

Whereas, in 1914 there were comparatively few motor-driven appliances and very few heating devices on the market for domestic use, to-day almost every housekeeping operation can be performed electrically and judging by the new developments which are thrust before us almost daily many unheard of operations are being made possible by this wonderful servant of man.

Of recent years an attempt has been made to estimate the number of major or commonly used electrical appliances in use in Ontario, chiefly among Hydro consumers and while the estimates are more or less inaccurate, due to the impossibility to secure in every instance correct information, nevertheless, a steady growth in the number of appliances in use is indicated by the figures which are available for the years 1924, 1925 and 1926.

The table which follows shows roughly how the estimates for 1926 have been prepared and shows also by comparison the figures for 1924 and 1925 and also indicates the percentage of consumers on the Hydro Systems in Ontario who are using each type of appliance.

As it was impossible to secure from every municipality in the Province an accurate count of the number of each of these appliances in use it was necessary to apply average conditions to fill up the vacant spots caused by missing information. Questionnaires were sent out to every municipality in the Hydro Systems

asking them to fill in on specially prepared sheets the number of appliances estimated or actually counted to be in use among their consumers. In a great many cases municipal officials have found it profitable to send men out to count the number of appliances being used and have reported such to us. In many other cases only a few of the appliances have been so counted, while in other cases estimates were submitted which may or may not indicate the trend of the use of electricity in these particular municipalities.

A number of municipalities also refrained from sending any information whatever and on account of all of these circumstances it was impossible to make a very accurate estimate of what is actually going on. However, it is remarkable to note that with the passing of time the estimates which come in show a general increase in the number of appliances used. While the precaution is taken to inform the municipal officials each year of the estimates which they reported the year previous, nevertheless, where actual counts are made to take the place of previous estimates, such estimates are found to be very little out of the way.

In tabulating the returns received the Province was divided into four or five districts and the averages for each district were applied to take care of the municipalities in each district from whom no information was available so that on the whole it is felt that the figures which were submitted bear very close relation to the number of appliances actually in the homes of Hydro consumers.

Further study of this table shows that in practically every case the percentage of consumers in Ontario making use of each of these appliances is gradually increasing. It is possible, of course, for a decrease to occur where the percentage of increase in the number of consumers served is greater than the percentage of consumers served by any appliance, although there may be an increase in the number of appliances used. It will be observed that in some cases, particularly among smaller appliances, there is a decrease in the estimated number in use. This may be due to the fact that in previous years some municipalities may have over-stated or over-estimated figures which have been corrected by actual counts and these discrepancies are more or less unavoidable.

In the case of ironing machines and electric refrigerators, it is believed that there are more of these two appliances in use than are shown on this table for the reason that while consumers in the larger cities are most apt to be purchasers of equipments such as these, it was impossible to get even an estimate of the number of these appliances being used in the larger cities, and by applying the general average developed from figures received from the smaller municipalities that average is low, and it is fair to assume that there will be considerably more of these appliances in use than are shown in the report.

During 1926 there has been a growth in the installed capacity of

TABULATION SHOWING THE NUMBER OF THE LARGER ELECTRICAL APPLIANCES REPORTED IN USE BY HYDRO CONSUMERS IN ONTARIO AT DECEMBER 31, 1926, ALSO TOTAL NUMBER ESTIMATED AS IN USE IN 1924, 1925, 1926, AS WELL AS THE PERCENTAGE SATURATION IN EACH CASE.

	Estimated number in use Dec. 31, 1924.	Percentage saturation.	Estimated installed capacity in kw., 1924.	Estimated number in use Dec. 31, 1925.	Percentage saturation.	Estimated installed capacity kw., 1925.	Number of municipalities reporting in 1926 out of Total of 262.	Number of wired homes represented in 1926 by reports out of Total of 376882.	Number of appliances reported in use Dec. 31, 1926.	Calculated Total, number in use Dec. 31, 1926.	Percentage saturation.	Estimated installed capacity kw., 1926.
Ranges	47,505	13.8	285,030	56,562	15.9	339,322	209	353,420	67,589	70,883	18.8	425,298
Hot Plates	18,883	5.5	37,766	15,321	4.3	30,642	182	171,691	11,617	25,291	6.6	50,582
Washers	55,342	15.8	11,068	63,172	17.7	12,634	202	195,052	41,438	78,063	20.7	15,612
Vacuum Cleaners	64,205	18.6	12,841	72,660	20.4	14,532	197	192,237	39,784	75,120	19.9	15,024
Water Heaters	16,665	4.8	25,000	24,726	7.0	49,452	164	213,523	16,257	26,069	6.9	39,100
Grates	15,075	4.4	30,150	8,724	2.4	17,448	138	174,555	7,414	16,812	4.4	33,624
Portable Heaters	103,000	30.0	82,400	104,084	29.3	83,267	168	141,918	39,013	106,025	28.0	84,820
Ironers	1,590	.4	4,770	1,953	.5	5,859	96	134,780	767	2,255	.6	6,765
Irons	307,800	89.2	203,148	286,141	80.5	188,852	195	157,541	134,502	311,377	82.9	205,508
Refrigerators	657	.2	130	1,345	.4	269	104	147,792	973	2,667	.7	533
Toasters	152,200	44.1	83,710	149,700	42.1	82,335	194	152,958	70,105	160,077	42.5	88,042
Grills	46,800	13.8	30,888	37,068	10.4	24,472	160	140,236	17,000	42,000	11.2	27,720

electrical appliances in use in Ontario of from 849,134 kilowatts to 992,828 kilowatts, or approximately 143,694 kilowatts, or over 191,000 horsepower.

Granting that there is a considerable diversity in the use of these electrical appliances, an idea of the possible demand among domestic consumers can be gained from these figures: An increase in connected load of 191,000 horsepower in one year for electrical appliances only, with a possible further increase for lighting purposes with a diversity of five would mean an increase in demand of over 40,000 horsepower, and when we consider that on the average there is less than 15 per cent. saturation on a connected load of over 1,300,000 horsepower, there is ample market for power from the St. Lawrence River and other undeveloped sources and if present increase in demand keeps up, which it will, these other sources of supply will have to be tapped before very long.

Association of Municipal Electrical Utilities

Minutes of Meeting of Executive Committee

A meeting of the Executive Committee of the Association of Municipal Electrical Utilities was held at the office of the Hydro-Electric Power Commission of Ontario, Toronto, on Thursday, September 8, 1927, the following members being present: Messrs. J. J. Heeg, Chairman; J. G. Archibald, O. H. Scott, C. T. Barnes, W. R. Catton, R. J. Smith, D. J. McAuley, V. S. McIntyre, T. W. Brackinreid, R. H. Starr, T. J. Hannigan, and S. R. A. Clement.

It was moved by Mr. W. R. Catton and seconded by Mr. V. S. McIntyre that the minutes of the last meeting of the Executive Committee, as published in the *Bulletin*, be taken as read.—Carried.

The Treasurer then made a report on the finances of the Association.

Mr. J. G. Archibald, Chairman, Convention Committee, presented a report of a meeting of that Committee held on the same morning, as follows:

To the President and Executive of the Association of Municipal Electrical Utilities:

The Convention Committee beg to report as follows: We have secured accommodation at the King Edward Hotel for Wednesday and Thursday, January 18 and 19, with practically the same arrangement as last year, having the use of the ballroom for the banquet on Wednesday evening.

The cost to the Associations for the two luncheons and the banquet will be four dollars and fifty cents ($4.50).

We recommend that the Convention be held on the above dates and that the Secretary be authorized to close the matter with the King Edward Hotel.

We also recommend that we join the members of the Electric Club at the Wednesday luncheon.

We further recommend that no speaker be engaged for the banquet, but that a light form of entertainment be arranged for, this to consist

of music, songs, and other forms of amusement. This can be arranged, we expect, with only nominal expense.

We hope to be able to make arrangements so that members may be able to visit the Repair Department of the Toronto Transportation Commission on the morning following the days of the Convention.

Respectfully submitted,

(Sgd.) J. G. ARCHIBALD,
Chairman, Convention Committee.

The adoption of the report of the Convention Committee was then moved by Mr. J. G. Archibald, which on being seconded by Mr. R. H. Starr, was CARRIED.

It was suggested that instead of setting aside one portion of a Convention session as a joint meeting with the Ontario Municipal Electrical Association, that two sessions be arranged, one-half of the time of which to be given to the presentation of a paper by the Association of Municipal Electrical Utilities, and the remaining time to one obtained by the Ontario Municipal Electrical Association. It was, therefore, moved by Mr. R. H. Starr and seconded by Mr. C. T. Barnes, that the Association of Municipal Electrical Utilities prepare for the presentation of four papers during the Convention, and the Ontario Municipal Electrical Association prepare for the presentation of two papers, which was carried. It is proposed that the two sessions of the second day be divided according to the suggestion.

The Secretary then referred to a letter from the Western Section, International Association of Electrical Inspectors, calling attention to a Convention to be held at Toronto on September 27, 28 and 29, and advised that the membership would receive within a few days an invitation to attend this Convention and copy of the programme.

There being no further business, the meeting then adjourned.

The Expanding Use of Electric Power

Whether a saturation point exists in any industry is a doubtful point. Even in such an essential thing as food, or a particular food commodity such as flour, lower prices or increased buying power brings an increase in demand. Even in the best of times there are millions of people somewhere in the world who have a little less than enough, while those more comfortably fixed are always ready to substitute something a little better for what they are already using. For instance, rye made into bread constitutes one of the cheapest foods. But bread from wheat flour is distinctly better, and with every increase in their prosperity the people of Russia and of southern Europe use a little more wheat in place of rye. Nor does this necessarily imply a reduction in the output of rye, for rye can be made into whiskey, to satisfy a still more luxurious demand.

One industry at least that seems capable of indefinite expansion is electric power. Electric power will go just as far as coal or water falls will permit it, for these are the bases

from which electric power is made. The big advance in the cost of coal in the past ten years has switched many industrial plants from direct use of coal for power to use of electricity, while new mechanical devices have broadened the market for electric power both in the factory and in the home. At a meeting of the National Electric Light Association at Atlantic City in June, James E. Davidson said : "Probably no industry is further away from the saturation point than the electrical industry. Not even half the homes in America are wired for electricity, and since they are not wired, their doors are closed to nearly all appliances of manufacturers. Among the houses that are wired a very large number have an insufficient number of outlets and even where they are sufficiently lighted, ten per cent. of the sockets are empty. Thousands of homes have only irons and perhaps but one other time and labor saving electrical device."

We have cheap coal in the Maritimes, in Alberta and in British Columbia, and without doubt it will be applied more and more to the production of electricity in these sections. But the big hope for Canada's supply rests in our water powers, of which as yet scarcely 30 per cent. are in use. And these water powers are for the most part situated in the central provinces, which have no coal. Freight charges run the cost of coal in these sections to high figures, and therefore make it possible to use water powers that are relatively distant and expensive.
The Monetary Times.

Use of Fractional Horse Power Motors

THE uncontrolled introduction of many small motors on lighting circuits has brought new problems to the Electric Utilities. It is vitally necessary that motors with better and more efficient electrical characteristics be installed in situations where the need for such equipment is indicated. Some associations representing the Electric Utilities in the United States, therefore, sought the co-operation and assistance of appliance manufacturers and motor manufacturers in an endeavour to fix a standard for such motors. The *Electrical World* in its issues of July 3, 1926, February 5, and March 12, 1927, reports three conferences that have been held for this purpose, and considerable progress has been made. Some features brought out at these conferences are outlined in the following:

It is the desire of the power companies to furnish their customers with the best and most efficient devices in the belief that only by selling the maximum service at a minimum expenditure for energy consumed can an ever increasing demand for the service be maintained. That the introduction of the high efficiency tungsten lamp had actually been the means of increasing the use of energy for lighting was cited as an instance of the effect of promoting the use of

electrical equipment of maximum efficiency. Similarly the central-station industry is urging the use of the most efficient motors on electrical appliances which operate over sufficiently long periods of time to make the energy consumption significant.

Tests conducted during the past two years have demonstrated that many makes of the fractional horse-power motors now sold with such appliances have most undesirable electrical characteristics, requiring large starting currents, having low full-load efficiencies and operating at very low power factors. The existence of a few lines of such motors having much better characteristics and in actual use on similar appliances shows that it is commercially feasible to produce and sell a product much better adapted for operation on lighting circuits.

It is expected that appliances of the character in question, particularly refrigerating machines, oil burners, dish-washers, washing machines, etc., will not only continue to be installed in large numbers, but a very great increase can be anticipated in the first two mentioned in the immediate future. For this reason, it seems desirable to take such steps now as may be necessary to insure the use of motors which will entail minimum charges for operation by the user and minimum investment on the part of the electricity supply companies.

Discussion brought out the fact that the use of motors with unnecessarily low power factor and efficiency on equipment of the type under discussion increases the cost both to the user and to the central station company, in addition to affecting the quality of electric service which the customer receives. With the increasing number of people living in suburban towns adjacent to metropolitan cities, the service requirements of customers upon the power companies are becoming ever more exacting. Even in the more densely populated urban districts it was pointed out that in many families where both the man and wife are working, washing and ironing machines are being operated at night during the lighting hours. Operation of these devices causes objectionable voltage fluctuations which result in complaints to the service company from the customers. To alleviate this condition, it has become necessary for the power companies in many instances materially to increase their investment in distributing equipment; that is, transformers, secondaries, services wires, etc. As the central companies' investment, which is directly affected by power factor ranges, say, from \$100 to \$200, or more per kv-a., it has been found that the installation of a ¼ h.p. motor with low power factor characteristics requires an additional investment in system capacity of \$20 or more. This in turn is ultimately reflected in higher rates for energy consumed.

Efficiency of the motor becomes an important consideration to the user of appliances operating over long-hour periods and moderate increases in efficiency would result in a very considerable saving over a period of a year.

A number of central-station companies have, however, already found it necessary to place certain restrictions upon the capacity of motors which may be connected to their 110–120-volt lighting circuits. One company reported making a very considerable expenditure to increase the size of service wires and in some cases change the motors of customers using coffee mills, meat grinders, shoe repair machines, house pumps, oil burners, dish washers and other devices. Another company has issued a rule that any motor intended for use on lighting circuits shall not require more than 15 amperes to start, otherwise it should be made for 220-volt service. Many power companies are considering the promulgation of a similar rule and there is a strong tendency toward adopting such restrictions on the characteristics of motors which may be connected to lighting circuits.

Motor manufacturers pointed out that they are confronted by the necessity of meeting the specifications of appliance manufacturers, which are not always compatible with increasing the power factor and efficiency of the motor. Some of the conditions to be met are excessive low voltage in some localities, high starting loads on some appliances requiring high starting torque, space limitations and price. Greatly increased apparent efficiency could only be obtained at considerable increase in cost.

Appliance manufacturers felt that to use a motor costing considerably more than those now used would tend to reduce sales, in that it would introduce increased sales resistance in the form of increased retail price to the ultimate purchaser.

It was the sense of the discussion that the problems could best be solved by each group, recognizing the limitations of the other and effecting a compromise which would be mutually agreeable without putting all of the burden upon the power company, the motor manufacturer or the appliance manufacturer. For the purpose of more readily determining the logical steps looking to improvement in the electrical characteristics of fractional-horsepower motors, it was decided that two sub-committees should consider the requirements to be met under the two general classes of application; that is, first, motors which start and stop frequently, have comparatively long-hour operation and use considerable energy, such as on refrigerators and oil burners, and second, motors operating intermittently and using a relatively small amount of energy, such as those on washing and ironing machines.

A set of specifications and limitations was prepared and submitted to the two sub-committees. The committee on refrigerator and oil-burner application, after making some slight modifications approved and recommended the following:

1. These specifications apply to motors which are normally connected to lighting circuits and which may be expected to operate at times during the lighting hours.

2. The ¼ h.p. motor shall have at least such full-load efficiency and full-load power factor that the product of these two values, known as the apparent efficiency, shall not be less

than 42 per cent. Such test to be obtained after reasonable running time (at least 24 hours) to limber up motor. The values for other sizes shall be adjusted accordingly. This is to become effective Jan. 1, 1928, or as soon before that date as practicable; also, these requirements shall be considered to apply only to 1,800-r.p.m. motors.

3. It is desired that as rapidly as possible motors shall be produced which in the 1,800-r.p.m. ¼ h.p. size shall have a full-load efficiency of at least 70 per cent. and a full-load power factor of at least 65 per cent., giving an apparent efficiency of at least 45.5 per cent.

4. No motor (either repulsion, split-phase or other type) intended for use on 110–120-volt circuits shall have a starting current of more than 15 amperes. If a motor is of such a capacity or has such characteristics that it would require more than 15 amperes to start, it should be made for 220-volt service. The locked rotor value of current shall not exceed 20 amperes.

5. Motors should be so connected to appliances that unnecessary noise is avoided, so that bearings are readily accessible for oiling and so that all parts which may require attention may be reached and inspected readily.

The committee on intermittent-duty motor application was faced with more complicated problems, and it was decided to carry out a further investigation of the situation before making specific recommendations. The investigation will be made along the following lines:

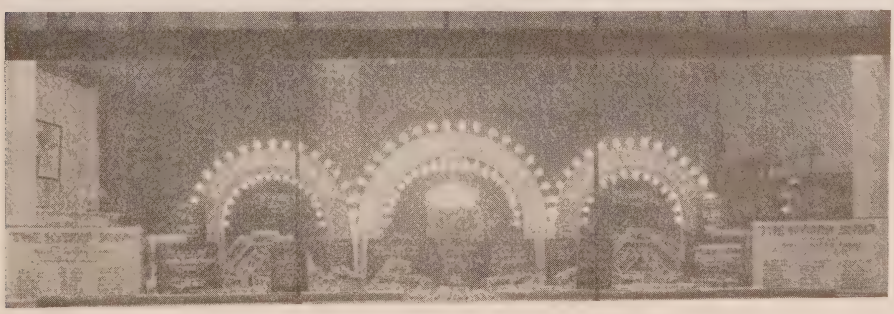
1. Investigation of when and where washing machines are used.

2. Washing and ironing machine manufacturers will give motor manufacturers their starting, running and pull-out torque requirements.

3. Motor manufacturers taking these data will ascertain what improvements can be made in split-phase motors and the consequent change in price.

4. Central-station representatives will submit an exhibit of installation costs borne by central-station companies involved in connection of washing or ironing machines to their lines.

Another meeting of this committee will be called as soon as the above information is available, when it is expected that definite recommendations on small-motor specifications can be made.



Hydro News Items

Central Ontario System

A new 44,000 volt, 3 phase circuit is being constructed from Port Hope to Oshawa and a new 44,000 volt line is being built from Oshawa to Whitby, while a new 1,500 kv-a, station is being erected by the Municipality of Whitby. Extensions to the Oshawa and Bowmanville stations are also being considered. This new work has been caused by the increased loads in the municipalities of Bowmanville, Oshawa and Whitby; in particular, the General Motors Co., at Oshawa is calling for a greatly increased supply of power.

* * * *

Additional transformers are being installed to take care of increased loads in the city of Belleville. These transformers will not be located in the present Belleville station but at the switching towers some distance outside the municipal limits.

* * * *

The Excelsior Mills in the Village of Pickering are now operating for the first time by electrical power. The factory is taking about 60 h.p. and great satisfaction is expressed on account of the greatly increased output which is obtained by the electrical drive as compared with the old steam drive previously used in this factory.

A new rural line is proposed from Peterboro to the villages of Bridge North and Chemong Park.

Niagara System

A rural Superintendent has been appointed, with a field office at Exeter to operate the rapidly growing Exeter Rural Power District. This district has for some time been operated for the Commission by the Exeter Hydro-Electric System.

* * * *

The sub-station at Delaware is being increased by 150 kv-a. to provide for the rapidly increasing load in that district.

* * * *

The Sarnia Hydro-Electric System is arranging for the purchase of two, 1,500 kv–a. station transformers. There are a number of new prospective loads in view, one being a large elevator now being constructed on Sarnia Bay.

* * * *

Work will shortly be commenced in connection with the installation of a new out-door sub-station at Shedden, in the St. Thomas Rural Power District. The station will have a capacity of 150 kv-a.

* * * *

The Goderich Water & Light Commission is arranging for the installation of new water pumping equipment consisting of an electric driven domestic pump and two gasoline engine

driven fire pumps. The latter will replace the old steam driven pumps, which have been in service for many years.

* * * *

The St. Lawrence System

The construction of a rural line is under consideration, to supply residents of the Hamlet of Berwick in the Chesterville Rural Power District.

Estimates have been revised on the cost of supplying power to the Village of Finch.

* * * *

An extension is proposed to supply rural residents west of the Police Village of Williamsburg.

* * * *

Power is being supplied to a sawmill at Williamstown in the Martintown Rural Power District.

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in August, 1927.

Appliances

THE BONNY ELECTRIC CO. (Submittor), 7 Redpath Avenue, Toronto, Ont.

HOWARD FURNACE Co (Mfr.), 881 Yonge Street, Toronto, Ont.

Portable oven and two-burner hotplate.

* * * *

BUCKEYE BLOWER COMPANY, Columbus, Ohio.

"Heatovent."

* * * *

V. D. COGLON, 2480 Dundas Street, West, Toronto, Ont.

Insect Exterminator.

* * * *

MACEY SIGN CO. LTD., 75 Elm Street, Toronto, Ont.

Electrically-illuminated display signs for general use.

WARD MANUFACTURING COMPANY, INC., 937 Wellington Avenue, Chicago, Ill.

Electric Curling Iron. "Eatonia."

* * * *

*M. ABRAHAM (Submittor), 329 Rusholme Road, Toronto, Ont.

CID ELECTRIC HEATING CO. INC. (Mfr.), 603 E. Washington St. Indianapolis, Ind.

"Cid" Portable type instantaneous water heater. Type B–B.

* * * *

*ATWATER KENT MANUFACTURING Co., 4700 Wissahickon Ave., Philadelphia, Pa.

Radio "B" current supply unit. Type "R" and Type "S." "Atwater Kent."

*The Film and Slide Company of Canada, Limited (Submittor), 156 King Street W., Toronto.

Bell & Howell Co. (Mfr.), 1801–15 Larchmont Avenue, Chicago, Ill.

"Filmo Automatic Cine Projector." Portable, motor-operated motion picture projector.

* * * *

*Griswold Mfg. Co., The, Erie, Pa.

Electrically-heated waffle irons and griddles. Cat. Nos. 110–G–E, 150–8–E, 150–G–8–E, 160–8–E, 160–G–8–E.

* * * *

*Sentry Safety Control Corp. (Submittor), Lincoln Bldg., Philadelphia, Pa.

Motion Picture Film Protector.

Fittings

*Kew Manufacturing Corp., 9 Bethune Street, New York, N.Y.

Extension Socket. "Lo-Lite."

Switches

Eagle Electric Mfg. Co., 59–79 Hall Street, Brooklyn, N.Y.

Thermo-operated sign flashers. "Eagle."

* * * *

*Allen-Bradley Co., Milwaukee, Wis.

Automatic Switch, Type J–1552, Form M. Type J–1552, Form T. Type J–1552, Form B. "Allen-Bradley."

Portable Lighting Devices

Ecanada Art Pottery (George Emery), Box 170, Hamilton, Ont.

Portable Electric Lamps.

* * * *

Kopp Glass Inc., Swissvale, Pa.

Portable Electric Lamps.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.—*Editor*

THE BULLETIN

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University Centenary Celebration

DIGNITY and grandeur prevailed during the Centenary Celebration of the University of Toronto on the 6, 7, 8, and 9th of this month. During the opening ceremony and special convocation, as well as the processions to and from these functions, there was a spectacle that will long be remembered on account of the large number of the alumni in their academic robes of various colours, and again at night when the buildings were flood lit, the grounds presented a scene equally magnificent.

Jointly with the University Centenary, the Faculty of Applied Science and Engineering (formerly known as the School of Practical Science) held its sixth reunion, to celebrate the 50th anniversary of the founding of the "School." This reunion assisted greatly the work of the Centenary movement as the registration of Science men alone totalled nearly one thousand.

The "School" celebration opened with a "get together" luncheon at the King Edward Hotel, which was attended by over 600 graduates. These included, in addition to men from various parts of Canada and the United States, one who had come from China. On the same day the Installation Ritual of the Calling of an Engineer was conferred upon some 400 graduates. After this ceremony an old-time "Smoker" was held when an elaborate programme was presented. The "School" dinner dance was held at the King Edward Hotel on the evening of the second day, it having been felt that this extra entertainment was required to supplement the Centenary Ball in Hart House on the same evening. The expectations of the Dinner Dance Committee were more than realized as there were some 680 guests present.

On Saturday morning there was general meeting of the Engineerin Alumni Association, after which

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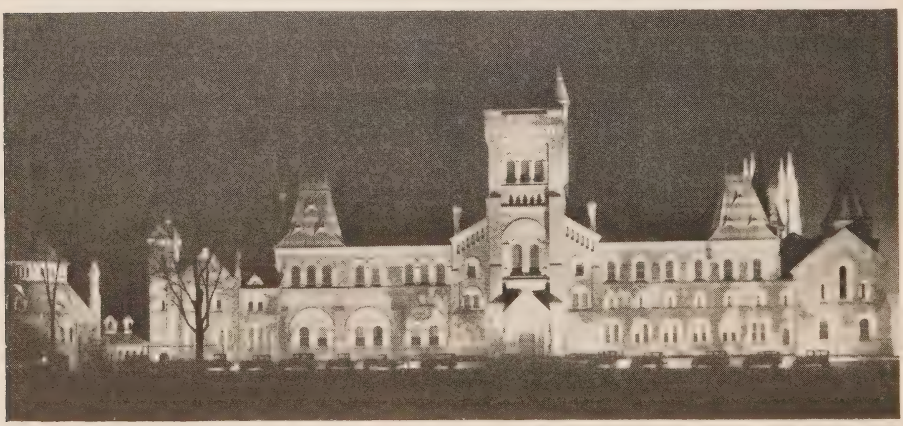
bronze memorial bust of the late John Galbraith, founder of the School of Practical Science, and first dean of the Faculty of Applied Science and Engineering of the University of Toronto, was unveiled and presented to the Board of Governors of the University. The presentation was made by Mr. J. M. R. Fairbairn, Chief Engineer, Canadian Pacific Railway, and President of the Engineering Alumni Association, and was accepted by Rev. Canon Cody, Chairman of the University's Board of Governors. Immediately after the presentation, some 500 "School" graduates were entertained in the Great Hall at Hart House to a buffet luncheon by the members of the Science Faculty.

The big event of the reunion was the banquet at the King Edward Hotel on Saturday night. The speaker on this occasion was Mr. E. W. Beatty, President, Canadian Pacific Railway. Brig.-General C. H. Mitchell, Dean of the Faculty of Applied Science and Engineering of the University of Toronto, and Mr. H. Walker, Chief Inspector of Mines for Great Britain, also spoke.



University College, University of Toronto

Aerial Survey Used for Transmission Line Location

By A. C. Goodwin, Engineer Transmission Dept., H.E.P.C. of Ontario

AERIAL photography has been successfully used by the Hydro-Electric Power Commission of Ontario in locating and purchasing easements for the 200-mile, 220,000 volt transmission line now under construction from Fitzroy Harbour, on the Ottawa River, to Toronto. This line, when completed, will carry 260,000 h.p. for which the Commission has a contract with the Gatineau Power Company.

The eastern 120 miles of the country which this line traverses is a rough, undrained lake district, with much brush and timber and with few roads or trails. The western 80 miles consists largely of well-settled agricultural lands, with scattered bush, rolling in places. For the eastern 120 miles, the location of the transmission line was therefore controlled by the physical characteristics of the country, and the main problem was to obtain as straight and as short a line as possible, without crossing any lakes. For the western 80 miles, the main problem was to obtain a straight short, easily constructed line, at the same time missing villages, farms, schools, and other such like buildings, orchards and valuable bush, and generally avoiding damage to existing property without doing excessive clearing.

Locating The Line

The first procedure in locating the line was to project and lay down on the best maps available for the purpose the general route of the transmission line. For this operation, practically the only maps available were the township maps, and the standard government topographical maps, 3.95 miles to the inch. On enquiry from several sources, it was found that these maps were not reliable as to detail, and hence any line laid down on them could not be relied upon to miss the lakes and other physical obstructions which actually existed. This, by the way, has been proven by the aerial photographs, and cases have been found where lakes are one-half mile from their map location, and in other cases, lakes shown on the maps have turned out to be swamps. It was, of course, known that a great many small lakes were not shown on the maps at all, and it was also discovered that certain roads shown on the plans did not exist, and that sometimes the most direct roads as shown on the maps were really quite indirect. Also, in many townships, it was found that plans did not show the lots broken in the centre, which condition in one case, caused the survey party (before aerial photographs were received) considerable inconvenience in paralleling certain lot lines in the field.

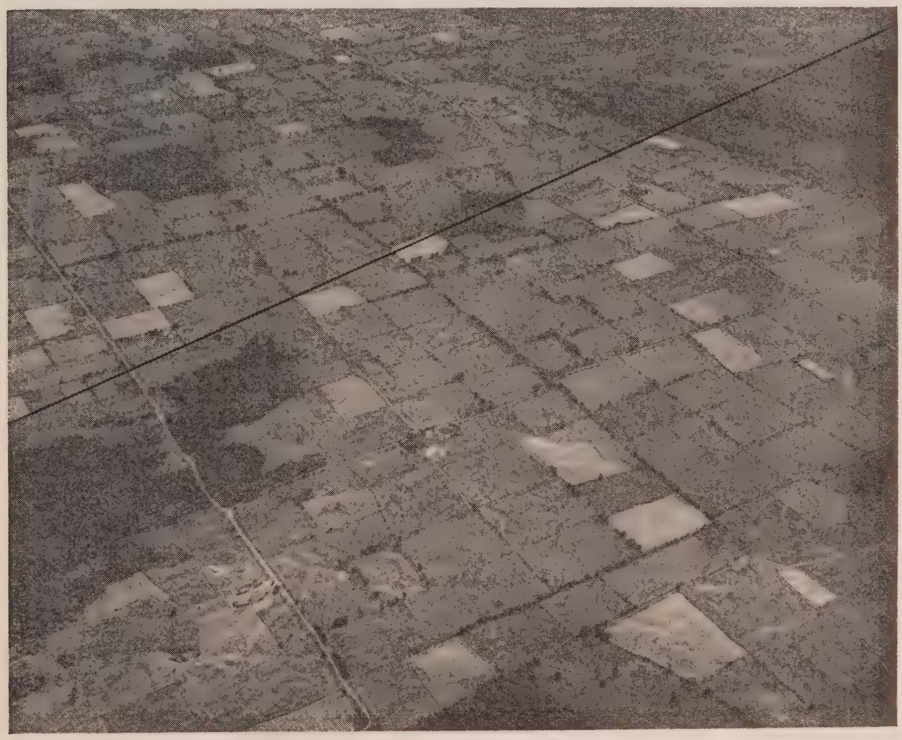
It was apparent, therefore, that the next step, that of projecting the transmission line in the field, presented real difficulties. Without

Map Showing Location of Gatineau-Toronto 220 kv. Line

accurate information regarding the lakes and other physical obstructions existing along the 120 miles of rough and isolated bush country at the eastern end of the line, it was obvious that the work of any survey parties put in the field would be slow and expensive, largely a matter of trial and error procedure, requiring in the first instance a general triangulation, with traverses to locate obstructions, and the running of trial lines. The absence of well defined land marks also made survey work difficult. An aerial survey was therefore considered and adopted, as against a preliminary field survey, as being both cheaper and quicker, and at the same time giving assurance of the best possible location of line. The aerial survey had other advantages which will be described later.

The Aerial Survey

The organization that undertook the photographic work used a seaplane, equipped with pontoons, that was capable of a flying speed of 100 miles an hour. At this speed, it would, of course, only take a few hours to take a complete set of pictures, providing weather conditions were favorable, but for a survey of this nature a couple of months should be allowed, because delays, due to climatic conditions are quite frequent.



Oblique Photograph in Agricultural District

Vertical Photograph in Agricultural District

On the eastern section of the line and as far west as Rice Lake, there are lakes within gliding distance of the centre line, but from Rice Lake to Toronto there are very few suitable landing places for a seaplane, and as the plane did not carry sufficient gasoline for a flight to the Company's Ottawa River base from Toronto after a photographic flight, at the other end of line, it was decided to establish a base in the centre of the route.

As a basis upon which to work, the Aerial Survey Company were given a copy of the map already referred to, (scale 3.95 miles to the inch), showing the projected centre line from Ottawa to Toronto on which they were to take two sets of oblique photographs, one from either side. The reason for taking two sets of obliques was that the possibility of other lines in this territory had been considered and to take care of future requirements, detailed information covering a wide strip of country was necessary to decide where the logical location of the first line should be. The understanding with the Aerial Survey Company was that these obliques would be used to locate or revise the line with sufficient finality to allow vertical photographs to be taken over the final location.

While the oblique photographs revealed no major obstacles to the line as projected, many small changes were necessary, and in one difficult section, it was necessary before taking the verticals to arrange for the flying of an H.E.P.C. locating engineer over that part of the line.

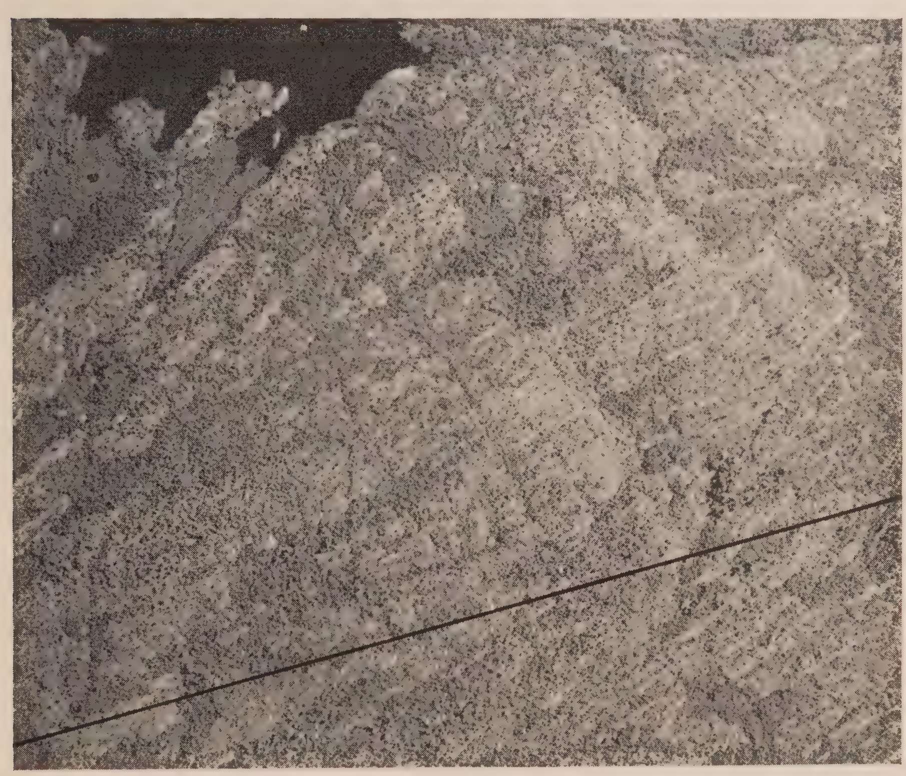
The vertical photographs were taken at a height of approximately 6,000 feet over what was now fixed as the approximate final location of the line, and were then made up into

matched mosaics in strips about 22 inches long, showing in great detail a strip of country averaging about 1¼ miles in width.

The finished matched mosaics were made at a nominal scale of 1,000 feet to the inch, which distance however, was found to vary from about 950 feet to 1,050 feet on the final pictures, although all sections of the photograph were in correct proportion. This variation is probably due as much to the difference in elevation of the country along the line of flight as to the different altitudes at which the pictures were taken.

Advantages of an Aerial Survey

By the use of these pictures expensive preliminary field surveys have been practically eliminated and the work of line location has been much facilitated. The matched vertical mosaics show clearly and in great detail a strip of country each side of the final centre line. Lakes, forests, cultivated and uncultivated land, buildings, fences, orchards, and wooded lots are clearly discernible. The concession and lot lines stand clearly as they actually exist on the ground, as also do railroads, highways, roads, trails, rock outcrop and rivers. One



Vertical Photograph, 800 ft. per inch, of Easterly Section of line in Lake District with limited cover over rock.

Assembled Mosaic near Town in Westerly Agricultural District of Toronto-Gatineau Line.

can discern without trouble small hilltops, ridges, and the gullies washed by rainstorms; and looking closer it is possible to count the trees in the orchards, the shocks in the fields, and to even discern drainage furrows and windrows. By using the stereoscope on the 7 by 9 in., vertical "contact prints," which have a 50 per cent overlap, the topography of the country stands out for approximately one-half mile on each side of the line, and hence it has been possible to lay down on these vertical mosaics a much more direct and shorter route than would otherwise have been possible, and to use it with confidence as the best possible final line location; also, in some sections, to spot towers without any field work at all.

By the use of aerial maps the Commission's right-of-way agents have been able to go out into the field and secure options or easements for right-of-way without any preliminary field work. It has been possible by the use of the aerial photographs to show clearly to the various owners the location of the proposed line without going out and tramping all over the fields. The advantages to all parties of this method of purchasing right-of-way can readily be appreciated and in practice it has resulted in considerable saving.

The only work for the field parties was the location of the line on the ground as indicated on the photographs, the running of a profile along the centre line, noting property ties and ownership of land passed over, and the staking out of tower sites. The field parties were supplied with prints of the vertical mosaics upon which the centre line was marked and with very few exceptions were able to work without any changes in location, missing all houses, buildings, and other obstructions. The vertical photographs were of the greatest value in speeding up this necessary field work as well defined objects on the photographs were easily located

on the western section as a means of tying in the line; the general topography, lakes, rivers, trails, barren spots, thick bush, etc., serving the same purpose on the more difficult eastern end. It is remarkable that it has been possible to run tangents up to nine miles long which have checked within a few feet. It is the Commission's opinion that the line is much more direct and of shorter route than any one that survey parties could have located without assistance from aerial photographs.

A Permanent Record

Another very valuable feature of these photographs is that they provide a detailed, accurate, permanent and easily accessible record of what is on the ground. The records of a field survey would at the best be very sketchy compared with an aerial photograph and would consist of little more than a centre line, fringed with a sprinkling of survey data. The information on the aerial photographs will be of the utmost value during the period of construction, enabling the distribution of material to be worked out to the best advantage, which is itself quite a problem in this isolated bush country where transportation costs mount up to a considerable figure. It is also expected that construction camps and material dumps can be located to the best advantage by the use of the photographs with other maps available.

With the stereoscope it is even possible to distinguish thick or thin bush, whether the timber is large or small, and therefore, on the basis of this knowledge, clearing contracts were let with local farmers before survey work was done, although the centre line was run before cutting commenced. The mosaics have also been used to check up in the office the area cleared before final payment was made. In several locations where more detailed information was required for station sites, etc., enlargements have been made and these have proved of great value.

Assembled Mosaic in Easterly Lake District.

Power Developments on Gatineau River

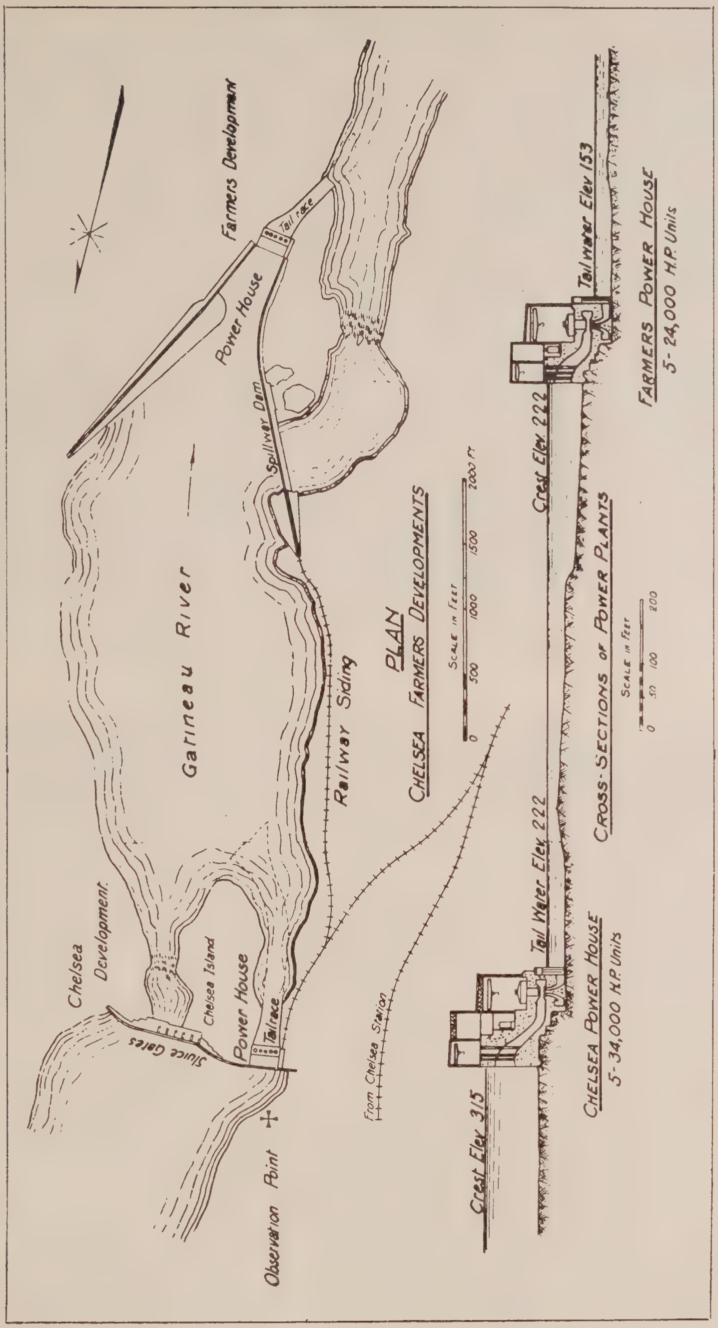
By the courtesy of "The Canadian Engineer," we give a description of the general plan of development of the Gatineau River and of the Chelsea and Farmer's Rapids plants which will be tied in with the Paugan Falls plant. The article was prepared by Mr. R. C. Rowe, Mining Engineer, Buckingham, Quebec. This is of particular interest since the Commission, to meet its ever increasing demand for electric power, entered into a contract with the Gatineau Power Company early in this year for a supply from its proposed plants on the Gatineau River in Quebec. The Power Company started immediately the construction of three plants, at Chelsea, at Farmer's Rapids, and at Paugan Falls, from which plant the power is to be transmitted to the point of delivery to the Commission. We hope to publish at an early date an article descriptive of the Paugan Falls plant, which will supply the bulk of the power to the Commission over 220 kv. lines.

EVEN in these days, when super-power projects are the rule rather than the exception, the development of the Gatineau River by Gatineau Power Co., stands out as a unique achievement in several ways. On the lower reaches of the river there are three developed powers aggregating 562,000 h.p. This is, in itself, a development of colossal proportions which renders the scheme one of the biggest and most ambitious on this continent, and the world. The equipment used is the most up-to date, and incorporates one, or two new departures in smaller details. Another point that renders the project, in its entirety, unique is the apparent over-development of the various power sites. "Apparent" is used here intentionally because the scheme really takes into consideration the conservation of water, and the scientific analysis of peak load periods in a way that has been largely lost sight of in this country of abundant water power, but which is used to its full extent in other countries.

We will touch on this phase of the operations in a latter part of this article; but it can be stated here now that, this high development of power sites can only be brought into operation economically where a company, such as the Gatineau Power Co., practically controls an entire river, and can, therefore, regulate and utilize the flow to suit its own purposes.

In order that this angle of the proposition can be viewed in its proper perspective it may be in order to briefly describe the broader features of the development, though, probably, many readers are familiar with them.

Gatineau Power Co., is a Quebec corporation, all the common stock of which is held by International Paper Co., and the development of the Gatineau River is, therefore a part of the vast program of expansion entered upon by the latter company in Canada. Gatineau Power Co., is



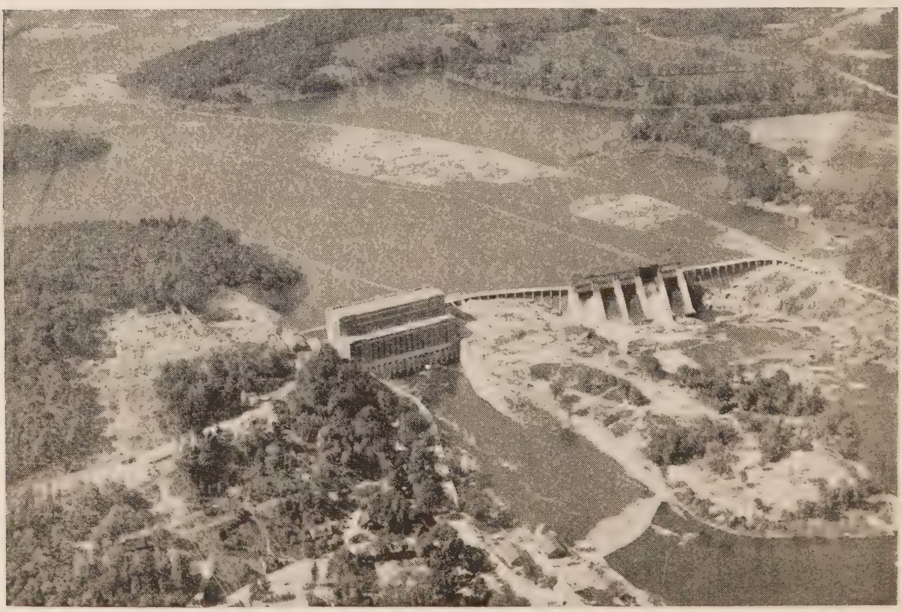
Plan and Cross Section, Chelsea and Farmer's Rapids Developments.

starting out under particularly auspicious circumstances, as it is in the very pleasant position of having a large part of its ultimate power output already contracted for. The Hydro-Electric Power Commission of Ontario will, by 1931, be taking 260,000 h.p. per annum from the Gatineau plants; the Canadian International Paper Co., will be taking anything up to 74,000 h.p., and the Canada Cement Co., 3,000 h.p.

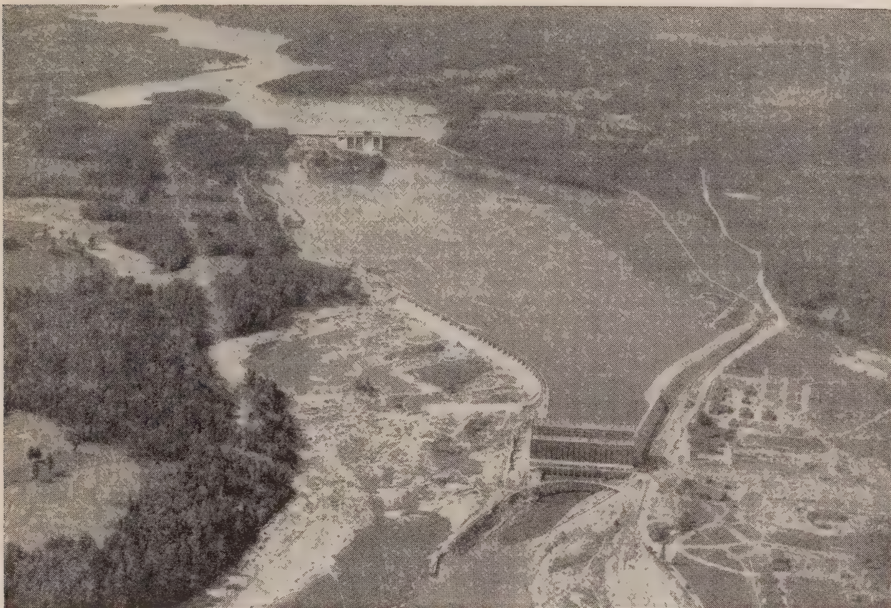
The Gatineau River is the largest tributary of the Ottawa, which it joins at Gatineau Pointe a short distance down-stream from the city of Ottawa. It is about 240 miles long, and has its source between the headwaters of the St. Maurice and Ottawa Rivers. It is a turbulent river, and has long been noted for its scenic beauties. Like most of our northern rivers, it is a flashy stream, with a normal average low water flow of around 2,500 sec. ft. In freshet seasons it attains flood proportions, and has, at times, seriously menaced the little village of Gatineau Pointe.

Naturally, this condition has necessitated the installation of a storage system on a large scale. This is located in the vicinity of Bitobe, over 120 miles upstream from the mouth of the river. The Bitobe storage system impounds 95,000,000,000 cu. ft. of water for release during low water periods, and a normal regulated stream flow of about 10,000 sec. ft. is expected under this arrangement.

Downstream about ninety miles from Bitobe is located the Paugan Falls power plant, which is designed for an ultimate capacity of eight



Aeroplane View of Chelsea Power House and Dam



Farmer's Rapids Power Plant, Chelsea Development in Background

34,000 h.p. units, operating under a head of 135 ft. Some twenty miles further downstream are the plants at Chelsea Falls and Farmer's Rapids, both within nine miles of the City of Ottawa. The plant at Chelsea is designed for five units of 34,000 h.p. each, and that at Farmer's Rapids for five 24,000 h.p. units. The former operates under a head of 96 ft., the latter under a head of 66 ft.

The description of equipment contained in this article will be limited to the two latter plants, as these are now in operation.

A brief glance at the accompanying diagram will show that these two plants are, in a sense, one large development. In fact, the original scheme called for one power house at the foot of Farmer's Rapids, with penstocks from the dam at the head of Chelsea Falls. This was, eventually, abandoned in favor of the present plan with its two distinct installations.

The dam at Chelsea is a ponderous structure of which the power house forms a part. It consists essentially of five control gates flanked by spillways. It has a crest level of 315 ft., which has created a large storage lake about twelve miles long. The creation of this lake necessitated the moving of several miles of railway and provincial highway, and it also flooded a large area of land.

Three of the control gates are 50 ft. by 30 ft., and two are 50 ft. by 20 ft. They, and the operating superstructure, were fabricated by Canadian Vickers Ltd. The gates are operated by two movable cranes, which is an advance over the old

method of having an individual operating mechanism for each gate. Steel stop blocks are provided on the upstream side for use in case of repairs to the control gates.

A feature of the general development is the chute for the passage of logs from the Chelsea pond to below the Farmer's power house. This is 7,000 ft. long, and is provided with a floating boom inlet. It uses about 200 sec. ft. of water, and the author was told that it takes exactly five minutes and forty-five seconds for a log to complete the passage. Its capacity is rated at 75,000 logs per day.

The power house forms part of the western portion of the dam. It is a steel and brick structure, with concrete substructure, 300 ft. long by 140 ft. wide overall. It follows conventional power house design, consisting broadly of generator room, transformer bays, gate room, oil switch floor, motor disconnect floor, control and switch rooms, with offices, bath rooms, etc.

Briefly, the plant may be summarized as being designed and operated on the unit system. Each generating unit having its own bank of transformers and auxiliary equipment, and connecting directly to the high tension bus. All electrical equipment in this plant was supplied by the Canadian Westinghouse Co.

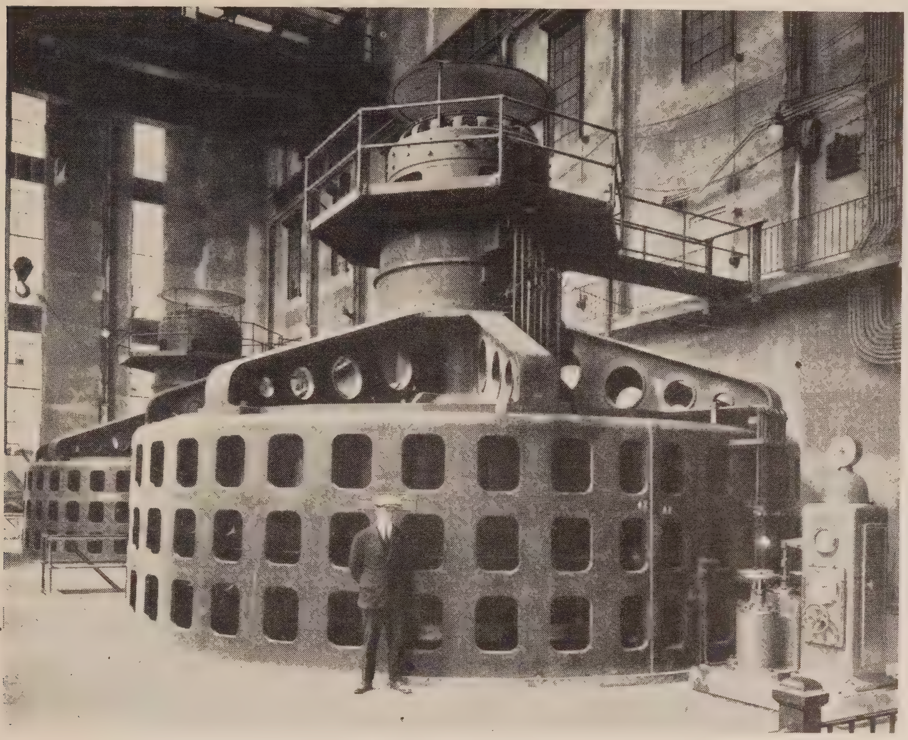
The generator room will house five 36,000 kv-a. vertical units delivering current at 6,600 volts. Three of these are at present installed, two of which are 60 cycle units, and one of 25 cycles.

The two 60-cycle machines at present installed are shown in one of the accompanying photographs, and a good idea of their size can be gathered from a study of it. They are just under 30 ft. in diameter, being, as a matter of exactness, 358 in. They stand 270 in. overall above the floor. The rotor weight is 175 tons. Exciters are directly connected, and are 275-volt, 900-ampere machines.

The 25-cycle generator is practically the same size as the 60-cycle; but the rotor weight is 200 tons. The 25-cycle generators will eventually feed into the 250-mile transmission line to Toronto for taking care of the Hydro-Electric Power Commission's contract, and they have been designed for very good voltage regulation, and provided with a special excitation system. This consists of an auxiliary generator, which is directly connected with the main unit, which feeds into an induction motor driving a separately excited generator, which in turn provides excitation for the main unit. Under this system, to quote Canadian Westinghouse Co., "it is possible to maintain voltage on the system, even in spite of severe disturbances on the transmission line."

These units were stacked and wound on the job. Insulation on both armatures and field coils will stand an operating temperature of 150 deg. Centigrade. Individual strands, and conductors of the armature coils are insulated with mica. Insulation between turns of the field coils of asbestos, and between the field coils and the poles, mica and bakelised asbestos is used.

All units are fitted with Kingsbury bearings, lubricated by a force feed



Generators No. 1 and 2 at Chelsea Power House

circulating oil system operated under a pressure of around 35 lbs. Each unit carries its individual lubricating system, consisting of pumps, etc., but is connected with a central force feed lubricating system which is thrown in when the oil of the individual system needs changing, or in case of breakage or accident.

Each generating unit is driven by a 34,000 h.p. I. P. Morris turbine, direct connected, at a speed of 100 rev. per. min., under a 93-ft. head. The turbines are made by Dominion Engineering Works, Ltd., Montreal.

Woodward governors, made by the Woodward Governor Co., are used for turbine speed regulation. They are of the motor driven fly-ball type The motor is driven off the main generator leads, and is extremely sensitive to any changes in speed. Special safety devices close the gates in case of voltage breakdown. These governors are guaranteed to be sensitive to speed variation of less than ¼ of 1 per cent. and to hold the speed to ½ of 1 per cent., under gradual load changes. In the governors used at Chelsea and Farmer's, oil is only used in the pilot valve system, actual movement of gates being effected with water under a pressure of from 135 to 150 lbs. per sq. in.

The pump room is situated in a sunk well in the middle of the genera-

tor room. The installation for providing water for the governing system consists of one turbine-driven, and two motor-driven Cameron pumps. The turbine in question is provided with its own intake and draft tube. Water is pumped from concrete suction tanks direct into the governor system. The central lubricating system is located in the pump room, together with fire pumps.

The transformer floor lies level with the top platform of the generators, at the back of the generator room, on the upstream side. It is divided into seven bays, five of which will carry the banks of transformers for each generating unit, with one transformer at each end for auxiliary service.

Each bank of transformers consists of three single-phase, 12,000 kv-a., water cooled transformers. The generator voltage of 6,600 will be stepped up to 110,000 for transmission purposes. The auxiliary transformers are three phase, 1,000 kv-a., and they will step down from 110,000 volts to 550 for auxiliary service round the plant, such as oil pumps, water pumps, elevators, control gate mechanism, etc. The auxiliary switch room is located at the back of the transformer floor.

Above the transformer floor is the oil switch floor, carrying five 110,000 volt oil switches, which can, of course, be operated by hand, or are automatic in case of accident. And above this again are the motor operated disconnects.

The control room is located at the top of the building, and carries five control panels, and five instrument panels. The motor operated disconnects are operated from the control room, and all safety devices for the plant and transmission lines will be housed here.

Six transmission lines will run from Chelsea, carrying current at 110,000 volts. These are as follows:

Two lines of 60-cycle to Farmer's and Gatineau plant.

Two lines of 25-cycle to Farmer's and Gatineau plant.

Two lines of 25-cycle to Paugan Falls.

The layout at the Farmer's Rapids plant is almost identical with that at Chelsea, but with the lower head of 66 ft., the power output is smaller.

Here again, there will be five generating units, three of which are being installed immediately, with two to follow. All five turbines are being immediately installed. The generators are built by Canadian General Electric Co., and the present installation represents a new departure for this company, as the machines were piled and wound on the job, this being the first time the company has employed this method of assembly in Canada. Of the three machines now installed, two are 60-cycle, and one 25-cycle. All the units are 6,600-volt, 3-phase, 25,000 kv-a. The rotors of the 60-cycle machines weigh 165 tons, and that of the 25-cycle, 199 tons. A distinctive feature of these machines is that, the upper guide bearing is entirely removable without dismantlement of the exciter, or any part of the upper structure. Exciters for the 60-cycle units are 250-volt, 760-amperes.

Lubrication is force feed under a pressure of 35 lbs., and like the Chelsea plant, each unit carries its individual lubrication system, with all units linked up with the auxiliary central lubricating system for use in case of emergency.

The generators are driven by 24,000-h.p. I. P. Morris turbines, running at 90 rev. per min. under a head of 66 ft., supplied by Dominion Engineering Works. Woodward governors are used.

The pump room lies in an open well in the generator room, and it contains one turbine driven, and two motor driven centrifugal Cameron pumps for governor service; two motor driven Rees-Turbo fire pumps, with a capacity of 1,000 gal. each per minute, together with the central lubricating system.

The general layout of the transformer floor, conduit tunnels, oil switch floor, disconnect floor and gate room is similar to Chelsea.

Transformers consist of individual banks for each generating unit, and there are three single-phase, 8,333-kv-a., water-cooled transformers to each bank. Current is stepped up from the generator voltage of 6,600 to 110,000 for transmission. The main transformers in this plant are made by Canadian General Electric Co., and they each carry 27,800 gals. of oil; the core and windings weigh 25,000 lbs., while the total weight, with oil, is 65,600 lbs. The auxiliary transformers are by Canadian Westinghouse, and are identical with those at Chelsea, as are, also, the oil switches and motor operated disconnects.

At the Farmer's Rapids plant will be installed a switching structure for all lines running south of Chelsea, together with a sub-station for a branch line running down to Hull, and the vicinity.

The auxiliary 550-volt service of both plants is tied in together so that, in case of breakdown at either plant, pumping, lighting, heating, etc., will be maintained, and both Chelsea and Farmer's will be tied in with Paugan Falls.

The power output of the Paugan Falls plant will be mainly utilized in supplying the current required under the contract with the Hydro-Electric Power Commission of Ontario, which will be transmitted over a 250-mile line to Toronto. Chelsea and Farmer's will serve the Gatineau paper mill and the area in the vicinity of Ottawa.

The 110,000-volt line to Gatineau is a two-tower line, with two circuits per tower, making in all, four 110,000-volt transmission circuits. The towers are of galvanized steel, supported on mushroom concrete footings The conductor is aluminum cable, steel reinforced of 605,000 circular mills, and is supported on suspension type insulators.

From the top of the Farmer's power house a bird's eye view of the whole lay out is obtained. Below is the pond of Farmer's plant, stretching up to the tail races of the Chelsea plant to the north. Running toward the east, as straight as an arrow, is the two tower line to the Gatineau mills, while running north are the lines toward Paugan. With all this below, the mind reverts to the scene

here, a short two years ago, when the waters, now so closely harnessed, thundered away unheeded and unused. All that we see here to-day, in its concrete and accomplished form, was visualized by men when these power sites were simply spectacular beauty spots, and we cannot help paying ungrudging mental tribute to the men who could dream of such things, and who had, furthermore, the power and the ability to convert their dreams into reality.

Here, but a few brief months ago, was an army of workmen, directed by a corps of engineers. To-day, most of the engineers and workmen have moved on, but what they built with the work of their head and hand will stand for many generations, a silent, but eloquent, memorial to the effort and the thought that was rendered and so brilliantly culminated here.

Taken generally, and in its entirety, the Gatineau power development is the product of the latest line of thought in hydro-electric power. It is based on the slogan that water is money—a fact that we have, characteristically, lost sight of in this country of ours where we have water to burn, if one may be forgiven for venturing into the realm of mixed metaphors.

To the casual observer, and the unversed, each power site on this river is overdeveloped. The consumption of each unit at Chelsea and Farmer's is over 3,000 sec. ft. The normal regulated flow of the river in low water seasons is expected to be 10,000 sec. ft. Thus, at a first glance, only three units at each plant can be run. This would naturally be entirely true if power requirements were not a variable factor, and it would also be correct if a full control of the flow of the river were not in the hands of the power company.

In the case of the Gatineau development, we have a very complete storage system. At Bitobe, up towards the head waters of the river,

Dam at Farmer's Rapids Development

Farmer's Rapids Development

there is the key storage of the system. At Paugan there will be another larger reserve of water, and at Chelsea and Farmer's another. All these plants and reserves are under the control of one company.

Obviously any one of these plants could operate all five units at peak load periods, and at such times, three of the units would be working on the normal stream flow, and two on the pond.

As all these plants get tied together, and as the company's contracts get tied into the system, and their requirements and peak load periods analysed and established, it will easily be seen that a very perfect system of water control can be evolved and synchronized with peak load requirements.

Thus, we can easily imagine a period when Paugan would be running heavily off its pond to take care of a heavy load. When this released water reaches Chelsea, Paugan would ease off and start to build up its loss from the Bitobe storage, and Chelsea and Farmer's would look after the load. Naturally, this is an ideal condition that is subject to many variations in practice, but the principle of using water in blocks, through successive plants, wasting none and wringing every dollar from it, is the basis upon which the present system is built.

This all requires very close observation, and very accurate correlation of data, to render it entirely effective.

In the operation of the Gatineau power system the conservation of water must be a dominating factor. Thus a system of rain gauges will be installed at points all through the surrounding drainage area. These will be in the hands of observant and intelligent persons, such as country storekeepers, school teachers, etc. After a heavy rainfall, these will send in the amount of fall, by telephone or wire, to the power house to which they will be tributary, and the operators will closely observe the results on the stream flow. As this data is correlated, the flow from reserves will be regulated accordingly. Thus, a very heavy rainfall in the lower reaches of the river might very easily augment the normal flow to such an extent that the reserve at Bitobe could be shut

off proportionately. After a while, the time can be very accurately gauged that the water, from a rainfall in any given area, will reach the ponds at Paugan or Chelsea, and arrangements can be made to store it or use it, and thus save the main storage of the system.

Obviously the successful and efficient operation of such a system requires a very close and accurate record of all conditions; a very intimate analysis of the records when kept, and a perfect control of the plants involved.

The Canadian Electrical Code

by W. P. Dobson, Laboratory Engineer, H.E.P.C. of Ont.

(Address before Western Section, International Association of Electrical Inspectors at Toronto, September 29, 1927.)

IT is probable that no subject in the field of industry has within recent years received more attention than that of standardization. This is true particularly of the electrical industry and among the standards of this industry the National Electrical Code was one of the earliest. This code has formed the basis of rules for wiring in the United States and Canada for many years, and dealt primarily with the fire hazard. The National Electrical Safety Code was issued by the Bureau of Standards and has for the past ten years formed the basis of rules dealing with the life hazard.

In administering rules of this kind, it was natural that local conditions should produce changes in the form of additional rules and that differences in interpretation should result in a diversity of requirements. The situation was thus eventually reached that it was found desirable to obtain uniformity in rules and in their interpretation and great efforts are now being made towards this end, in which efforts the International Association of Electrical Inspectors is a powerful agent. Diversity of local conditions and the difficulty (on account of distance) in securing frequent personal contact among inspection authorities make the work of harmonizing conflicting opinions very hard.

In Canada the same disadvantages of a multiplicity of codes, and the same difficulties in the way of securing uniformity have been experienced and a recital of the efforts which have been and are being made to secure satisfactory conditions may be of interest.

In 1919 the Canadian Engineering Standards Association was organized for the purpose of assisting industry by preparing specifications and standards. Shortly after it was organized, a request was received from Mr. C. LeMaistre, Secretary of the British Engineering Standards Association that a committee be formed to meet representatives of British electrical manufacturers to discuss the difficulties they were experiencing in obtaining acceptance of their goods in Canada. About the same time

enquiries were received from inspectors in different parts of Canada as to means of approving British electrical goods, and a suggestion that the adoption of uniform rules for wiring throughout the whole of Canada would be greatly in the interests of the manufacturers, the inspection authorities and the public.

A special committee was accordingly formed with instructions to meet the British representatives, and also to report on the advisability of attempting to formulate a Canadian Electrical Code. This committee addressed a questionnaire to the various interested organizations throughout the country and after considering the replies at meetings held in June and September 1920, recommended that the Canadian Engineering Standards Association attempt to formulate a code which would be acceptable to all parts of the country.

It was further recommended that the Code should include—

(a) Installation regulations to cover both inside and outside work.

(b) Specifications for methods of testing and approving electrical material, devices and fittings to ensure that they are suitably designed and of proper construction.

The Main Committee of the Canadian Engineering Standards Association received this report favorably and decided to call a conference of Provincial representatives to obtain an expression of opinion as to method of procedure. The Dominion Government at the request of the Association invited each Province to appoint delegates to a conference in Ottawa. The provinces of British Columbia, Ontario, Quebec and Nova Scotia appointed representatives, and a meeting was held in May 1923 at which the first three were represented.

This conference concurred in the report of the special committee and made the following recommendations:

1. That an Electrical Code be prepared which should provide for the fire and life risk.

2. That a preliminary draft should be prepared by one or two competent men who should give their entire time to the work.

3. That this draft be based generally upon the National Electrical Code, the National Electrical Safety Code, the Rules of the Hydro-Electric Power Commission of Ontario, and other local regulations in force in various parts of Canada.

The conference also outlined an organization for the prosecution of the work, consisting of a main committee and nine provincial sub-committees, one in each Province; the main committee to include representatives of the Dominion and Provincial Governments; the Fire Underwriters' Associations, the power Companies, Inspection authorities, the electrical manufacturers, contractors, jobbers and dealers, the railways, and the engineering and architectural societies. The provincial committees were designed to give fuller representation to local interest. It was proposed that the draft should first be submitted to the Provincial committees and that their criticisms and suggestions should be then considered by the main committee which would approve of the final draft.

This scheme of procedure was submitted to all interested organizations and approved by letter ballot and the various committees were appointed. Mr. A. A. Dion of Ottawa, was appointed Chairman of the Main Committee and Mr. F. A. Cambridge of Winnipeg, Vice-Chairman.

A meeting of the main committee which was attended by 15 representatives from Manitoba, Ontario and Quebec, was held in Montreal in May, 1924. This meeting approved the decisions of the previous conference and appointed Professor W. F. McKnight of the Nova Scotia Technical College, Halifax, and Mr. H. F. Strickland of the Hydro-Electric Power Commission of Ontario, as compilers of the Code. General instructions were given the compilers as to the course to be followed and the material to be included. It was decided that their first duty would be to draw up rules for inside installations and that they should follow, as far as possible, the arrangements, sections, numbering and text of the 1923 National Electrical Code, making such changes, however, as were desirable to avoid ambiguity, and to incorporate the necessary additional rules covering personal hazard.

The electrical manufacturers made contributions to the cost of the work and the compilers presented the first draft in the fall of 1924. This was submitted to the various provincial committees and detailed comments and criticisms were received from Nova Scotia, Quebec, Ontario and British Columbia. The Manitoba committee reported that in its opinion the instructions of the main committee had not been followed in that too great a departure had been made from the National Electrical Code.

The ensuing correspondence and discussion delayed further action for some time, and it was not until May 1926, that a meeting of the main committee was held in Ottawa to consider the draft. This meeting was attended by 17 delegates representing Nova Scotia, Quebec and Ontario. Mr. W. J. Canada, representing the National Fire Protection Association was also present. The draft was discussed in detail and adopted provisionally, several sections having been referred to special committees for further consideration.

Following this meeting considerable discussion occurred which did not serve to bring the various apparently conflicting views into agreement, and it was eventually suggested by the Manitoba committee that a plenary meeting be held in Winnipeg. About this time the revisions of the National Electrical Code were published and in order to expedite the work the Hydro-Electric Power Commission of Ontario offered the services of Messrs. Barnes and Strickland, for the purpose of going over the draft and incorporating the 1926 and 1927 revisions of the National Electrical Code. This work was completed in May 1927, and a meeting was held in Winnipeg in June, at which were present 25 representatives from British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, and Nova Scotia. Four days were spent in discussing the draft and after

revision in certain details it was approved for publication. It is now on the press and will appear in the course of a few days.

The first step towards uniformity has thus been taken. It is expected that the Code will be adopted by provincial and municipal inspection authorities throughout the country and it is hoped that it is comprehensive enough to make local rules unnecessary. Its adoption is, of course, optional on the part of inspection authorities, but the action of the delegates to the Winnipeg meeting insures its adoption in the inspection districts represented at the meeting.

The second part of the Code, viz., specifications for test and approval of equipment—involves the creation of laboratories for the purpose of carrying on the approval work. The creation of such laboratories under the National Research Council is now being discussed. In the meantime the Code recognizes the approval of Underwriters' Laboratories and of the Hydro-Electric Power Commission of Ontario.

A word as to the main features of the Code may be of interest. The aim of the compilers was to avoid ambiguity of expression and to arrange the material in a logical order so as to make it easy to find any desired rule and to interpret it.

One of the chief means of avoiding ambiguity was the preparation of definitions for all terms used in a special sense throughout the rules. Much thought was devoted to this and it is hoped that this feature will be of great assistance in the use of the Code.

Careful attention to phraseology is also necessary to avoid ambiguity and this received special attention at the hands of the compilers.

In the matter of arrangement the National Electrical Code has in the main been followed. Repetition has, however, been avoided when possible, and it is believed that in this respect the National Electrical Code has been improved upon. Rules dealing with the same subjects have been grouped together and repetition avoided. For example, all grounding requirements have been placed in the section on grounding (with the exception of radio grounding rules) and the section on "services" contains all rules pertaining to services.

One of the most important factors in the success of the work was the decision to entrust the preparation of the Code to a small number of competent men. The preparation of rules which shall be concise, simple and without ambiguity, requires that careful thought be devoted to phraseology, choice of words, and arrangement of ideas and this is not possible in committee meetings composed of large numbers of men who devote only a fraction of their time to the work. It is believed that in the Canadian Code we have a document in which the difficulties of interpretation have been reduced to a small degree. It is of course not perfect and experience with it in the field will suggest improvements in this feature. The work of Messrs. McKnight and Strickland in preparing

the first draft and Messrs. Barnes and Strickland in revising it for the Winnipeg meeting was an important contribution to the success of the work.

The Canadian Engineering Standards Association was particularly fortunate in obtaining the consent of Mr. A. A. Dion, one of the most prominent electrical engineers in Canada, to act as chairman. Mr. Dion devoted much time to the work of the committee and his death in 1926, shortly after the first meeting, was a great blow to the work and was sincerely regretted by all those who were privileged to work with him.

This paper has been chiefly a recital of the history of the Canadian Code, and is the first published record of the various steps in the work. The future of the Code in Canada will depend upon the extent to which it is adopted by inspection authorities. A satisfactory beginning has been made, however, in the undertaking by those present at the Winnipeg meeting, to adopt it. It is hoped that it will not be necessary to supplement it by local rules; this will depend upon the extent to which it is kept up-to-date and as the various committees are permanent the machinery for revision is in existence and it should be possible to keep it thoroughly up-to-date.

The Canadian Code is an example of what can be accomplished by a gathering of representative men who are sincerely desirous of reaching agreement. At the meeting in Winnipeg a very satisfactory representation from all parts of the country was obtained and it is confidently expected that the Canadian Code will shortly be universally adopted throughout the country.

Sixteenth Annual Safety Congress

THE National Safety Council, held its 16th Annual Safety Congress during the week of September 26th, at the Stevens Hotel, Chicago. The Hydro-Electric Power Commission of Ontario has been a member of this organization for years and has annually sent members of its staff to attend the various sessions. The attendance of over 5,000 representatives from the various industries created a record.

A new comer to the Congress is greatly impressed by the high calibre of the delegates, many companies being represented by their chief executive officers. In the Public Utilities Section, one of the papers was given by Mr. Frank W. Smith, Vice-President of the United Electric Light and Power Company, New York City, and a past President of the National Electric Light Association. The President of the Council for the coming year is Mr. Homer Neisz of the Commonwealth Edison Company, Chicago. Mr. Neisz is Manager of Industrial Relations for his Company and is a past President of the Western Society of Engineers.

The exhibit of safety devices was most complete. The various manufacturers of appliances all exhibited,

and a trip through the exhibition room itself was an education.

The Congress sessions were divided into 36 groups, commencing at 8.30 in the morning, and continuing throughout the day. We were naturally most interested in the Public Utilities Section papers. Every session was conducted in a prompt and business-like manner and the amount of business conducted in such a short time was marvellous. The bound proceedings containing the various papers, discussions, etc., require over 2,000 pages of printed matter.

At a congress during which safety was discussed from so many different angles and from such varied interests, it is difficult to choose any outstanding topic, but we feel the following are the most important:

1. Education of the Child in Safety.
2. The Humanitarian Side of Safety
3. Care, Selection and Discipline.

The Education of the Child in Safety, was stressed in all sessions. Consider the thousands of children of school age. Educate the child in safety. Teach it to take the proper care on the streets. Each child brings home its problems on Safety. Parents are interested in the work of the child, in the way they play, and thus unknowingly the message of safety has gone into the home, resulting in a happier family, a safer workman and a safe child. Intensive work has been carried on in St. Louis by means of radio talks and they have not had a child killed on their streets since July 1st. of the present year.

The humanitarian side of Safety should be emphasized. One very prominent Public Utility Executive stated that the economic appeal was over-done. The Executive knows the saving in dollars and cents, but does not always see the result of the accident to the victim or to those left dependent.

In the care, selection and discipline of employees, safety begins in the employment of the man. He should not only be chosen for the particular position, but also properly introduced to the job and its various hazards pointed out. He should be followed through and observed until it is decided that he is a safe man to keep. If any workman is a repeater of accidents, he should be tried out at less hazardous work and if no improvement is shown, as a last resort he is dropped from the payroll.

Television

by F. K. D'Alton, Assistant Laboratory Engineer, H.E.P.C. of Ontario

FOR many years, and probably even for some time before the first telephone was placed in service, it has been the dream of engineers to have a system whereby a person may view a distant scene, or see another person who is beyond the range of vision This would be "Television," and it would seem of special interest at present

if it would enable one to see before him, with every detail and every motion as in real life, the other party with whom he is conversing on the telephone.

Any method of accomplishing these results could rightly be classified as television, but on account of some of the problems which appear, it would seem that the objective can be obtanied only by combined electrical and mechanical means.

The Bell Telephone Laboratories in New York have succeeded in developing a system of television suitable for use with the long distance telephone and of such dimensions as to enable each speaker to view the other speaker (head and shoulders) while conversing.

An experimental demonstration of this system was given last April in which the speaker's image was transmitted from Washington to New York by wire—a distance of over 250 miles. The image was reproduced in a small rectangular space of a size suitable for direct viewing by one person at a time.

At the Summer Convention of the American Institute of Electrical Engineers in Detroit, on June 23 and 24, further demonstrations were given with the same equipment and those who were present had the opportunity of seeing both the transmitting and receiving equipment and also of discussing with the demonstrating engineers, the numerous difficulties which had been encountered and the probable field of usefulness of this system.

The transmitter and receiver were separated by a distance of several feet and each was practically totally enclosed.

In front of the transmitter and in a dark part of the room sat the subject, a young lady operator, with an apparently very faint light flickering across her face. At the receiving end the image appeared in a small illuminated rectangle shielded from side lights, and was remarkably brilliant. The subject was easily recognized in the image, and any movement was instantly shown on this viewing screen.

There were two very striking non-technical features in this system:

(a) The high brilliance of the image in contrast to the apparent faintness of the light which played on the face of the subject.

(b) The color of the glow of the Neon lamp at the receiving end was such as to introduce flesh tints in the image, suggesting the transmission of color, whereas this system is capable of transmitting in monochrome only.

Problems of Television

In the April, 1926, issue of the *Bulletin*, some of the methods for the transmission of pictures by wire were described and it was explained that the picture is reproduced by a weaving process in a period of about seven minutes.

For television, however, a very much higher speed of reproduction is necessary, for the "picture"—i.e., the subject—must be scanned completely at least sixteen times per second in order that the receiving image will not appear to flicker when viewed by the eye at the receiving

end. The system used for television must therefore be capable of illuminating and scanning the complete subject picture at very high speed, translating the variations in light into electrical impulses, transmitting this very large number of impulses accurately over long wire lines, and reproducing light variations of sufficient speed and accuracy to recreate the changing scene at the receiving end.

Another important problem of television is that of securing perfect synchronization between the transmitting and receiving equipment.

Illuminating and Scanning the Picture

In the human eye images are formed upon the retina which is a sensitive screen consisting of a multitude of individual light-sensitive elements each of which is the termination of a nerve fibre which goes directly to the brain. The entire group of many million fibres constitute the optic nerve.

Theoretically a television system could be made by copying the eye but this would necessitate a very large number of photo-electric cells and an equal number of conductors in the lines. To obtain even a minimum amount of detail in the image by this method, however, the number of wires or other communication channels would be impractically large.

For practical purposes reduction of the number of transmission channels is made possible by the fact that while in vision all parts of the image on the retina are simultaneously and continuously acting to send nerve impulses, the eye is capable of giving the sensation of a continuous impression from discontinuous signals, provided these succeed each other rapidly enough. Due to this phenomenon—i.e., "persistence of vision," a feature which is used in the viewing of a motion picture—it is immaterial to the eye whether the whole view be presented simultaneously or whether its various elements be viewed in rapid succession, provided the entire image be traversed in a sufficiently brief interval. The succession of these traverses, if there be sixteen or more per second, gives the impression of a continuous image, showing a large amount of detail and every movement of the subject.

For a television system to operate over electrical conductors, there must be some device which is sensitive to light and which will cause variations in electric currents in accordance with variations of light, and be sufficiently quick in response. Such a device has now been developed in the potassium hydride photo-electric cell.

The subject picture can be illuminated by direct light and a transparent image be formed through a high quality large aperture lens. At the point of focus of the image a revolving disc with a spiral of small holes could be used to scan the image by a series of ribbons of light. The intensity of light passing through these holes would vary according to the lights and shades of the subject and would actuate the photo-electric cell. Fig. 1.

While this method of scanning the subject is a possible solution of the problem, it does not appear feasible, however, on account of the very weak signal obtained from the photo-electric cell even with very intense illumination on the subject. With a system for transmission of a speaker's face the necessary illumination to give even a fair signal strength would require to be much more intense than one could endure.

To overcome this difficulty the engineers of the Bell Telephone Laboratories have used another method which is a reversal of that just described. The rays from a high-power arc light are focussed on a revolving disc in which there is a spiral of fifty holes. Fig. 2. These rays pass through only one hole at a time, forming a spot of light on the subject, and as the disc revolves this spot traces a ribbon across the subject. The holes in the disc, also being in a spiral, the spots of light from the different holes form a series of ribbons across the subject but at any one instant there is only one spot of light, about ½″ diameter, on the subject picture. This spot is intensely illuminated from the arc but does not cause the subject any inconvenience as it is in such rapid motion. The *apparently* very faint light which flickered on the subject was, in reality, this very intense spot in rapid motion.

The reflected light from this spot will vary according to the high lights and shadows of the subject, as it moves across the "picture."

In front of the subject there are placed three of the highly sensitive potassium hydride photo-electric cells. These are actuated by the reflected light from the subject, and in turn vary their current output in accordance with the intensity of the reflected light from the spot.

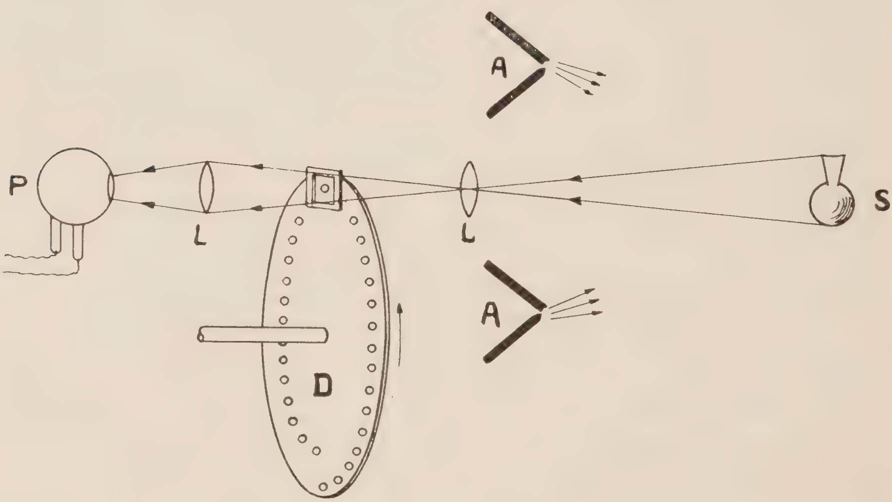


Fig. 1.—Several light sources (A) illuminate the subject (S). A lens (L) forms an image which is traversed by a spiral of apertures on the revolving disc (D) through which the light falls on a single photo-electric cell (P).

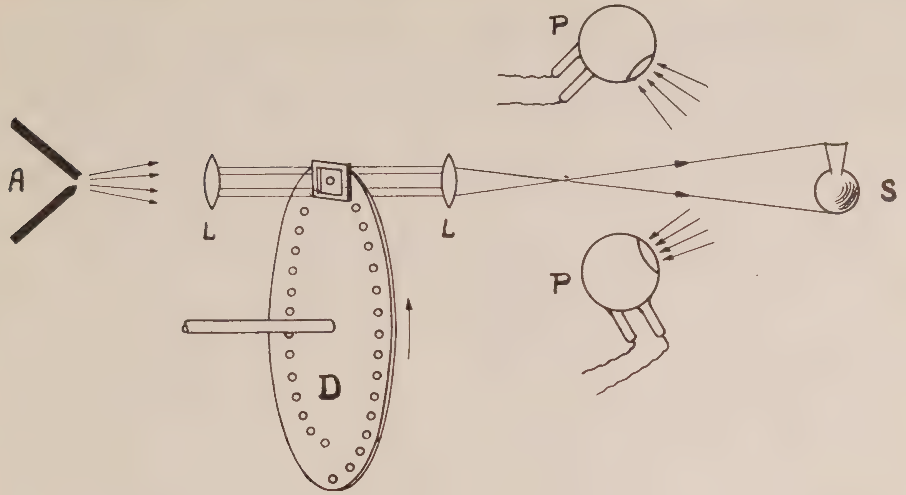


Fig. 2.—Light from a single source (A). The reflected light is received by several photo-electric cells (P).

This method of scanning the scene evidently is quite satisfactory. That part of the subject which is being transmitted at any instant is brightly illuminated and in order to increase signal strength it is necessary only to place more photo-electric cells in front of the subject.

Transmission of the Television Signals

In the equipment used in demonstration, the subject is scanned by fifty ribbons of light, corresponding to the same number of holes in the disc. Each ribbon may be considered as divided into fifty sections, or squares, so that the transmission of the complete subject picture would be the transmission of two thousand five hundred impressions. The complete picture must be scanned and transmitted at least sixteen times per second in order to prevent flickering at the receiving end, and therefore a minimum of forty thousand impressions must be transmitted per second over the lines.

To transmit a larger picture or scene, with the same fineness of detail, or to obtain finer detail in the same scene, would require the transmission of a relatively larger number of impressions. This sequence of impressions is equivalent to a high frequency—forty thousand cycles or higher—and as the number of impressions to be sent per second increases, the transmission difficulties also increase and soon become very serious. It is this problem of accurately transmitting higher frequencies which is limiting the size of picture, or, in other words, the fineness of detail, which may be sent by wire channels.

Before transmission the current signals from the photo-electric cells are amplified. They are first passed

through a resistance-capacity amplifier and then through further amplifiers to the open wire telephone line from which all repeating equipment has been removed. At the receiving end the signals are again amplified.

High frequency synchronizing signals and voice currents from the conversation are sent by separate channels. In the demonstration from Washington to New York these signals were sent through cables.

Recreation of the Image

For the reproduction of the image, it is necessary to have a light source which will vary in intensity with sufficient rapidity to respond to the impression signals. The ordinary sources of illumination have not this feature and therefore cannot be used for reproduction of the image from the received signals.

The light source found most suitable for this purpose is a Neon lamp with electrodes of special rectangular design. These plates will glow with a pink light upon passage of current through the lamp and this glow will rapidly vary in intensity according to the magnitude of the current.

In the demonstration apparatus, a single Neon lamp is operated directly from the received picture currents, after amplification, and the rectangular electrode glows over its entire area with a uniform intensity which at any instant is proportional to the initial luminous signal reflected from the subject in front of the transmitter.

The person viewing the scene at the receiving end looks at this electrode, but between the screen and his eye is a synchronized revolving disc with a spiral of holes—Fig. 3—similar to the disc at the transmitting end. As the disc revolves, these (fifty) holes pass in succession across the rectangular electrode and recreate the ribbons of light for the image. At any given instant, the position of the hole at the receiving end corresponds exactly to the position of the spot of light on the subject picture at that instant. As the intensity of light through the small aperture at any instant is proportional to the intensity of the reflected light from the subject and also the position of the spot and aperture are in exact agreement, it follows that the original scene is traced out at the receiving end, and all movements of the subject are instantly shown.

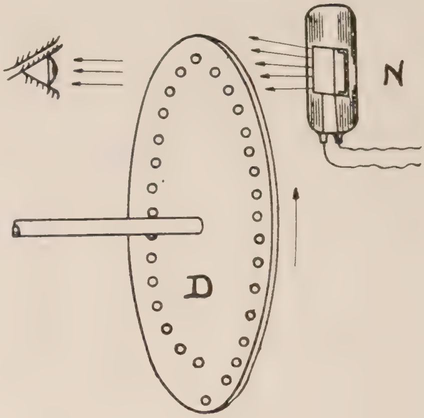


Fig. 3.—The electrode of the neon lamp (N) glows with an intensity proportional to signal strength at any instant. The eye sees the image at the disc (D).

The reproduced image is, of course, a monochrome.

Features of the System of Television

The chief reasons for the success of this system of Television are summarized as follows by the engineers who have brought it to the present state of perfection:

1. Choice of image size and structure such that the resultant signals fall within the transmission frequency range of available transmission channels.
2. Scanning by means of an intense projected moving beam of light.
3. Transmission of only alternating current components (i.e., variable components) of the image.
4. Use of self-luminous surfaces of high intrinsic brilliancy for reconstruction of the image.
5. High frequency synchronization.

The novel feature of transmitting only the alternating, or varying, components of the image gives some rather peculiar effects when it is remembered that the impressions are taken by reflected light.

The direct, or steady, component of the signals represents the reflection of all steady illumination from the subject. With this component eliminated, the image will not indicate whether the subject is sitting in the dark or in a brilliantly illuminated location. Also a light source in the subject-picture—as for example, a lighted match—may not appear at all in the image, or may even appear in reverse or dark, owing to there being much less of the light of the scanning beam *reflected* from the flame area, or other source, than from the high lights of the subject-picture.

At the receiving end the direct component is replaced and may be used to vary the general tone—i.e., brilliancy—of the image.

Applications and Future Developments

In the demonstrations which have already been given, and mentioned in preceding paragraphs, there have been in use only one transmitter and one receiver. These are both somewhat large in dimensions and it does not appear possible to place them sufficiently closely together to have both of them directly in front of the subject. The speaker on the telephone cannot be looking at the received image and also look directly at the television transmitter at the same time, but it will probably be possible to fit the transmitter and receiver so closely together that the one revolving disc may be used for both purposes, in which case each person will be directly before the transmitter and facing it and will have to look a few degrees upward or to one side to "see" the person with whom he is conversing. It will then be a two-way complete system on which further improvements can later be made.

At the present time it is difficult to predict what the chief uses of television will be. It is practically certain that it will always be a more expensive service than the telephone. This expense will probably increase in proportion to the size and quality of the transmitted image.

The kinds of service which are naturally thought of for television are: First, service from individual

to individual, complementary to telephone service; second, public address service, whereby the face of a distant speaker could be viewed by an audience while listening to his voice from a loud speaker; third, the transmission of scenic events to distant points, e.g., athletic contests, theatrical performances, etc.

The first two types of service appear to be physically practicable with apparatus of the general type already developed. For the third type, however, a much finer picture structure will be required for satisfactory results, and this will necessitate considerable advance in sensitiveness and efficiency in the apparatus, and also in transmission facilities.

For all three types of service, either wire or radio channels could be used as the problems appear to be equally capable of solution by either means. However, the fading phenomena characteristic of radio very seriously affects the image quality and it appears that television by radio will be restricted to those fields where wire facilities are not available.

References:

The Transmission of Pictures:—*Bulletin*, April 1926, p. 109.

Symposium on Television, A.I.E.E. Summer Convention, Detroit, Mich., June, 1927.

(a) Television:—Dr. Herbert E. Ives.

(b) The Production and Utilization of Television Signals:—Frank Gray, J. W. Horton, and R. C. Mathes.

(c) Synchronization of Television:—H. M. Stoller and E. R. Morton.

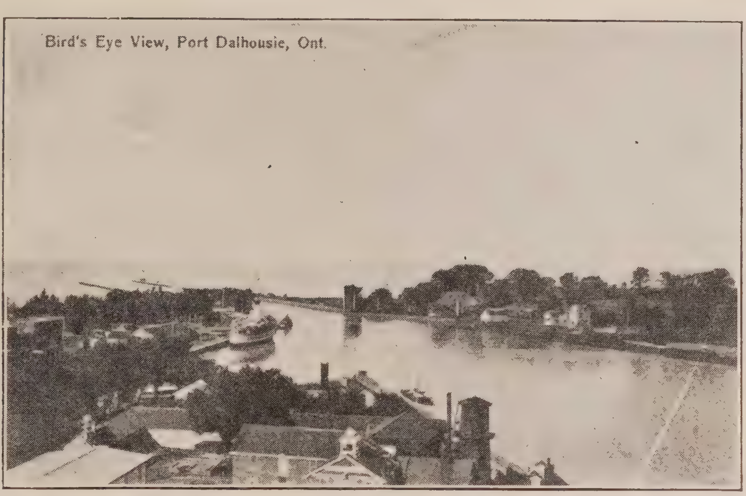
(d) Wire Transmission System for Television:—D. K. Garnett and E. I. Green.

Port Dalhousie

THE village of Port Dalhousie is situated on the south shore of Lake Ontario, and at the north end of the Welland Canal, which was commenced on November 30th, 1824, and finished in 1829, and to which the village owes its origin. The small settlement established here increased steadily until in 1862 it was decided to incorporate the village of Port Dalhousie, named after Earl Dalhousie, Governor-General of Canada at that time. Situated as it is away from the main lines of travel, the village has continued to progress and we now find it a thriving up-to-date community with a population of about 1550 people.

The first Welland Canal was built as a private enterprise by the Welland Canal Company, but was taken over by the Governments of Upper and Lower Canada in 1839. The locks of this canal were very small, being only 100 feet long and twenty feet wide, built of wood. Traffic at that date was carried on in very small sailing vessels, having a carrying capacity of between five and six thousand bushels of grain, the equivalent of three modern freight cars. The second canal was built between the years 1842 and 1845, the locks being 150 feet long, 26 feet wide and 10 feet deep, and were constructed of stone.

Port Dalhousie at that time contained only fourteen houses, Squire Pawling, one of the leading citizens, being magistrate, school teacher, farmer, post-master and store-keeper.



All of the land on which the village is is built was part of Squire Pawling's farm.

Following the building of the second canal, a flour mill and a floating dock were established at Port Dalhousie. In 1853 the Thorold and Port Dalhousie Railway, now a part of the Canadian National Railway System, was built, and in 1859 a large elevator was constructed to handle grain which was formerly lightered into scows.

The third Welland Canal, at present in use, was constructed in 1873-1882 with locks 250 feet long, 45 feet wide and 14 feet deep, capable of handling vessels loaded with from 75,000 to 100,000 bushels of grain.

Since that time the village has progressed with the times and has practically all the advantages of a city. Electric lighting service was first given in 1890, furnished by a private company, when coal-oil lamps which has been used for a number of years for street lighting were discarded. The electric plant was taken over by the village in 1912 and has since been served through the Hydro-Electric Power Commission of Ontario. In 1913 electric service was supplied to 241 consumers. This has increased steadily from that time until in 1926 there was a total of 581 users.

Several small industries are located here which together with the fact that the Canadian National Railways have established a summer park, is responsible for the village having reached its present proportions.

Port Dalhousie Public Utilities Commission controlling electric and water departments consists of Messrs. P. T. Atkinson, Chairman; A. C. Ferguson, Jos. H. Beaudette and Robt. A. Rennie, Commissioners. Mr. John M. Hare is the Superintendent and Mr. A. Wallace the Secretary-Treasurer.

Electrical Luxuries at Sea

Perhaps nowhere has electricity left so great a mark of improvement as in sea-going ships. Whereas to-day it is remarkable to find a deep-sea vessel without electric light, it is only a comparatively few years ago that the reverse was the case ; whereas to-day the Red and Arabian Seas, the Amazon, and the Equator conjure thoughts of electric fans and refrigerators, the memories of those who sailed to those parts in "wind-jammers" are not so pleasing. These floating hotels, as modern liners are sometimes called, owe most of their luxury to the application of electricity ; their newspapers, their radiograms, their lifts, lighting, and laundries have all been made what they are by a suitable use of electricity. The health of their passengers is cared for by electrically-driven exercising machines, having the motion of a galloping horse or a trotting camel. The purity and variety of their food is watched by refrigerator plant, in most cases electrically driven. The surgeries on board are fitted with all the modern conveniences enjoyed by the longshoreman's medical man, while the "barber's shop" is able to supply all those electrical treatments which make beauty a joy for ever. It is in the nature of things that we accept the progress of shipping with the same unconcern as we accept progress in other directions, and it is good, therefore, to look back over the mere handful of years, and imagine, if possible, modern ships without these applications of electricity. Conjure up pictures of the elaborate music rooms, salons, and writing rooms without their delicate lighting, their appropriate fittings, and their luxuriously subdued effects. Imagine the Red Sea without—a fan !—*The Electrician.*

Gold Filled Concrete for Colorado.

Gold-filled concrete for gold field pavement is the latest development from Colorado, where a five mile stretch of Federal pavement has just been completed north of Colorado Springs, in which the concrete contains something like $3,000 worth of the precious yellow metal to every mile.

This unusual concrete mixture was adopted by the Colorado engineers, not with any idea of faster spending of the state funds or of imitating the pavement specifications outlined in the Book of Revelations, but rather with the idea of pure economy, since it was found more economical to build the pavement with the gold in it than to construct it in any other way.

This peculiar situation came from the fact that the best coarse aggregate available for the job consisted of the crushed rock from the ore dump of the gold mines in the Cripple Creek district. These tailings assay something like $1.50 per ton, which is not quite enough to warrant the expensive operations necessary for the removal of the gold, but in no way interferes with the quality of the concrete.

The J. L. Brusselle Company, of Colorado Springs, probably had no difficulty getting men to work on the job, although there were no reports of any of the crew plucking a shining nugget out of the skip of the big Multifoote Paver with which the concrete was laid.—*Concrete.*

Mr. T. H. Hogg Honoured

Congratulations are due to Mr. Thomas H. Hogg, Chief Hydraulic Engineer of the Commission, on having received the honorary degree of Doctor of Engineering from the University of Toronto. This degree was created by the University to mark the semi-centennial of the founding of the School of Practical Science, now the Faculty of Applied Science and Engineering of the University of Toronto, and was conferred on Mr. Hogg and two other "School" graduates during the University Centennial celebration. We may be justly proud that one of the first recipients of this honour should be a popular member of the Commission's staff.

Thomas Henry Hogg

Visit of Manitoba Power Commission

Recent visitors to this Commission were: Mr. Douglas L. McLean, Deputy Minister of Public Works of the Province of Manitoba, Mr. M. A. Trott, Chief Engineer, Manitoba Power Commission, and Colonel Bingham. This visit was made on behalf of the Manitoba Power Commission for the purpose of studying the system of the Hydro-Electric Power Commission of Ontario as applying to rural service. More particularly was information sought regarding the methods of developing the rural districts, costs of construction and operation, and the possible revenues from the service.

The problem of supplying rural service in Manitoba is different from that in Ontario. It is not possible to get more than two consumers per mile of primary line. At the present time about 200 farms are being served from lines constructed from existing power centres, i.e., towns and villages where electricity is already

being distributed. The principal uses for power on the Manitoba farms is for lighting and threshing. At the present time, they have districts under consideration for extensions, that include about 700 possible farm services.

After leaving the office, the Manitoba delegation visited a number of farms where electricity has been in use for about ten years in the vicinity of Toronto and in the Woodstock district while en route to Windsor. They also planned to make observations of distribution system construction in other districts as they passed through them.

They were very much impressed with the progress that had been made in supplying electricity to farms in Ontario, as carried out by this Commission, and entertained a belief that with the information they were given and what they had seen, they would be able to more intelligently deal with the problems before them.

HYDRO NEWS ITEMS

Central Ontario System

A new 44,000 volt line between Oshawa and Whitby has been completed and a temporary station of 300 kv-a. capacity has been installed in Whitby. This will take care of the winter peak until the permanent 1,500 kv-a. station will be completed in the early spring. A new 44,000 volt line is being constructed from Port Hope to Oshawa.

* * * *

Messrs. Gooderham & Worts are constructing a new radio station, about 2½ miles outside the town of Bowmanville, in Darlington Township. This station will take about 50 kw.

* * * *

An additional 50 kv-a. transformer has been installed in the Marmora Station and three phase power can now be supplied in this village.

Niagara System

The Mitchell Public Utilities Commission placed an order recently for additional station transformers, which will bring the total installed capacity up to 450 kv-a.

* * * *

During this month a new outdoor type sub-station will be put into operation at Thamesford. This station will have a capacity of 225 kv-a., and will supply power to Thamesford, as well as Ingersoll and Dorchester Rural Power Districts.

* * * *

The Woodstock Public Utilities Commission recently purchased 3-150 kv-a. transformers, 13200/2300-575

volts. This equipment will be installed in the sub-station in the west end of the City.

* * * *

The distribution system in the Town of Watford has been overhauled recently, a large amount of additional conductor being added to take care of increased uses of the domestic consumers.

* * * *

A rural line is being constructed from Thamesville north as far as the Police Village of Florence; power will be available about December first.

* * * *

During the present year there has been considerable activity in connection with serving farm customers west of Waterford, and a short time ago a line was constructed to the Police Village of Villanova.

Service has recently been supplied to the new chopping mill, where there is installed a 15 in. double-head chopper driven by 2-10 horsepower, 3 phase motors.

Early in the present year, arrangements were made to supply a milk factory in Villanova and it is interesting to note that the cream is first separated and shipped to Toronto market and from the skimmed milk the casein is extracted. There is a large demand for casein at the present time for use in the manufacture of waterproof glue and for the coating of high grade newspaper. The waterproof qualities of the glue in the construction of laminated woods is particularly necessary where these are used in the manufacture of aeroplanes. A large amount of Canadian laminated stock is used in the United States for this purpose.

* * * *

A new street lighting system has been erected in the Police Village of St. Williams.

* * * *

A new Rural Office has been opened at Woodbridge, and a Superintendent appointed, with an organization to serve Georgetown, Brampton and Bolton Districts, as well as the Woodbridge Rural Power District, in all of which considerable extensions have been made.

* * * *

The extensions in the Bolton District include a street lighting system in the Village of Palgrave.

* * * *

The Markham District lines have been extended into Pickering Township and a street lighting system has been installed in the Village of Claremont.

Ottawa System

The Village of Richmond has carried by a large majority a by-law in favor of taking Hydro power, and a debenture by-law covering building of a distribution system.

Rideau System

A number of contracts have been received for lighting service in the hamlet of Balderson, and arrangements are being made to serve them.

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in September, 1927.

Appliances

*CRESCENT WASHING MACHINE DIVISION OF THE HOBART MFG. CO., Troy, Ohio.

Dish-Washing Machines, Models K, AM, AA, BB, CC, DD and FF.

* * * *

*DONGAN ELECTRIC MFG. CO., INC. 2987-3001 Franklin St., Detroit, Mich.

Air-cooled transformers, "Midget," "Dongan," "Miller," "A", "Tri-volt," "Multi-volt," "Junior," Type M-26, T-26.

Marking: Name and rating with terminal designation on case.

* * * *

*ROTH BROTHERS & CO., 1400 W. Adams St., Chicago, Ill.

Motor generator type rectifiers. "Roth Constant Potential System."

Marking: Nameplate attached to device bears manufacturer's name and address, trade name of the device, and the electrical ratings of motors and generators.

* * * *

*RITTENHOUSE CO., THE A. E., Honeoye Falls, N.Y.

Air-cooled transformers, Types SB, E-3.

Marking: "Ritco" or "Rittenhouse."

* * * *

STROMBERG-CARLSON TELEPHONE MFG. CO., 1060 University Ave., Rochester, N.Y.

"B" socker power unit. Code No. 401-A.

Marking: "Stromberg-Carlson."

* * * *

*UTICA PRODUCTS, INC., Utica, N.Y

Portable electric air heaters, combination reflector and convection type Model D, Model 3-H.

"Utica Electric Auto Heater."

Marking: Name plates with ratings.

* * * *

*WALKER DISHWASHER CORP., 246 Walton St., Syracuse, N.Y.

Porcelain enamelled dishwashing sinks with motor-driven water impeller.

Marking: Manufacturer's name, address, trade name, model number and serial number and motor nameplate showing rating.

* * * *

*WALLACE & CO., J. D., 134-58 S. California Ave., Chicago, Ill.

"Wallace" portable woodworking machine tools, including four types of circular saw, band saw, planer, jointer and lathe.

Marking: Nameplate with name and address of manufacturer and electrical rating.

* * * *

*YAXLEY MANUFACTURING CO., 9 S. Clinton St., Chicago, Ill.

Automatic power control radio switch, Series type, Cat. No. 444, multiple type, Cat. No. 445.

Marking: Manufacturer's name, catalog number of the device, type and rating "110 volts, 75 watts."

Fittings

*Beaver Machine & Tool Co., Inc., 625-43 North 3rd St., Newark, N.J.

Receptacles for attachment plugs. Composition base, Cat. Nos. L-5, L-9, L-10. Porcelain base, Cat. No. L-7.

Fixture canopy receptacles. Cat. Nos., L-51, L-52, L-54.

Marking: "Beaver."

Medium Base Sockets.

Candle Sockets. Keyless, Cat. Nos. B-31, B-41.

Medium Base Receptacles. Porcelain shell, keyless, Cat. Nos. 7692, 8303, 8692, 9062, 9350, 9821, 9840, 9870-71, 9873-78, incl., 9880, 9885, 9931, 10021, for use in fixtures only, Cat. No. 8101. Metal shell, keyless, Cat. No. 8691.

Medium base receptacles. Porcelain shell, keyless, Cat. Nos. S-3 to S-6 incl. Weatherproof, porcelain, keyless, Cat. Nos. S-21 to S-24 incl.

Composition attachment plug. Cat. Nos., F-1, F-5, F-6.

Separable composition attachment plug, Cat., Nos., J-1, J-21.

Stage type cord connector, Cat. No. Q-31.

Parallel blade attachment plug with wooden handle, Cat. No. J-35.

Current Taps (As listed on Underwriters' Laboratories card dated May 11, 1926.)

Marking: "Beaver."

* * * *

*Fibre Conduit Co., The (Mfr.), Orangeburg, N.Y.

Johns-Manville, Inc., (Sole Selling Agent), 296 Madison Avenue, New York, N.Y.

Under floor Raceways.

Marking: "Orangeburg" or "OBG" on duct, junction boxes and fittings.

* * * *

*Leviton Mfg. Co., 226-38 Newell St., Brooklyn, N.Y.

Medium base sockets, (As listed on Underwriters' Laboratories card dated April 15, 1927).

Medium base receptacles (As listed on Underwriters' Laboratories card dated June 28, 1927).

* * * *

*Ralco Mfg. Co., 123-41 N. Albany Ave., Chicago, Ill.

Receptacles for attachment plugs and plugs (As listed on Underwiters' Laboratories cards dated January 15, 1927, and January 14, 1927).

Switches

*Beaver Machine & Tool Co., Inc., 625 N. Third St., Newark, N.J.

Pendant Switches. Through-switch, Cat. Nos., D-3, D-4.

Miscellaneous

*Knox Porcelain Corporation, Knoxville, Tenn.

Radio lightning arresters for indoor or outdoor use. Air gap type, Cat. No. 1000. Non-air gap type, Cat. No. 1025.

Marking: "Knox" and wording "Radio Lightning Arrester."

* * * *

*Lowell Insulated Wire Co., Lowell, Mass.

Flexible Cord.

Marking: Two yellow threads parallel with wire between rubber insulation and braid.

* * * *

*METROPOLITAN DEVICE CORPORATION, 1250 Atlantic Ave., Brooklyn, N.Y.

Edison plug fuses, having porcelain heads slotted for sealing.

Marking: "M. D. Co."

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.—*Editor*

THE BULLETIN

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Another Year of Hydro Progress

By G. J. Mickler, Assistant Engineer H.E.P.C. of Ontario

AT the end of 1925 the results of the operation of the Hydro enterprise in Ontario during the previous twelve years, in the municipalities of the Province as a whole were presented in the form of tables and graphs to show—

(1) The growth in the rate of consumption of current by Domestic and Commercial lighting consumers.

(2) The gradual decrease in the average cost per kilowatt-hour sold to these consumers.

(3) The average monthly cost year by year per consumer for the power used as shown by lighting service bills.

(4) The average cost of power service for both industrial and municipal power during the year 1925.

(5) The average cost of power for street lighting service for the year 1925.

(6) A summary showing the average cost per kilowatt-hour for all services during the year 1925.

The results of these tables and graphs showed that the cost of Hydro power to consumers in Ontario is not only exceedingly low, but it is becoming steadily less in every branch of the service, and that services such as waterworks, street railway and street lighting are not required to pay more for their power than are domestic or other services.

The cost of municipal services as far as the cost of power to operate them is concerned is lower than the cost of any other service, so there is nothing hidden in tax bills to deceive the supporters of Hydro and Public Ownership.

Statistics of the operation of Hydro Municipalities during the year 1926 showing the results of such operation relating to the items mentioned above are provided in the 1926 Annual

CONTENTS

Vol. XIV **No. 11**

November, 1927

Report of the Hydro-Electric Power Commission and with these statistics the tables and graphs presented in the previous survey on the growth of Hydro have been incorporated into new tables and graphs extended to bring them all up to the end of 1926.

In preparing the tables which follow it was decided to show the results of every third year only in order to reduce the size of the tables and since the full information for each year up to 1925 was presented in the original tables last year. The figures for 1925 and 1926 however are shown so that the changes during the past year can be seen at a glance.

Table No. I., shows the data for cities of over 10,000 population for Domestic Service.

Several interesting points are brought to light by the study of this table. During the thirteen years covered in this table the revenue from domestic service has multiplied nine times; consumption has multiplied almost twenty-five times; the number of consumers has multiplied five times; the average cost per kilowatt-hour is one-third what it was in 1914; the average monthly bill has gone up about 75 per cent.; and the average consumption has increased five-fold.

Very much the same results are obtained in Table No. II. covering municipalities of between 2,000 and 10,000 population and also in Table No. III., covering villages under 2,000 population. And in Table No. IV., in which all previous tables are summarized we find that the number of municipalities has been multiplied by five; the revenue is ten times greater than it was in 1914; the consumption is almost thirty times what it was in 1914; the number of consumers is over five times what it was in 1914; the average cost per kilowatt-hour is about 36 per cent. of what it was in 1914 and the average monthly bill has increased about 70 per cent.; the consumption of current has increased over 400 per cent.

Just an observation on the relation between the increase in consumption and the increase in the average monthly bill. Think of it! The consumption has gone up over 400 per cent., and the average monthly bill increased only 70 per cent., showing a low cost of 1.81c. per kw-hr.

A remarkable thing in connection with this extremely low cost per kilowatt-hour is the fact that municipalities of Ontario distributing

TABLE No. I.

DATA FOR CITIES OVER 10,000 POPULATION

DOMESTIC SERVICE

Year	No. of Munici-palities	Revenue	Kilowatt-hours	No. of Con-sumers	Avg. Cost per Kw-hr.	Average Monthly Bills	Average Monthly Consumption Kw-hr.
1914	12	$ 614,925.00	12,646,400	55,597	4.86c.	$1.06	21.8
1917	19	1,063,264.00	36,693,100	107,248	2.89c.	$0.88	30.5
1920	21	1,926,924.00	84,328,000	154,186	2.29c.	$1.11	48.4
1923	21	3,772,416.00	206,266 200	223,028	1.83c.	$1.53	83.5
1925	21	4,765,263.00	278,515 400	244,336	1.71c.	$1.65	97.0
1926	21	5,374,069.00	324,290,285	255,109	1.66c.	$1.80	108.0

TABLE No. II.

DATA FOR TOWNS OVER 2,000 POPULATION

DOMESTIC SERVICE

Year	No. of Munici-palities	Revenue	Kilowatt-hours	No. of Con-sumers	Avg. Cost per Kw-hr.	Average Monthly Bills	Average Monthly Consumption Kw-hr.
1914	19	$ 90,330.00	1,414,500	7,410	6.38c.	$1.11	17.4
1917	27	180,075.00	3,824,600	15,731	4.71c.	$1.01	21.4
1920	36	353,915.00	10,053,100	24,041	3.50c.	$1.26	36.0
1923	43	651.499.00	25,411,300	34,135	2.56c.	$1.57	60.1
1925	48	888,507.00	42,305,200	42,854	2.10c.	$1.75	80.5
1926	48	1,037,016.00	50,487,035	51,044	2.05c.	$1.84	89.6

TABLE No. III.

DATA FOR VILLAGES UNDER 2,000 POPULATION

DOMESTIC SERVICE

Year	No. of Munici-palities	Revenue	Kilowatt-hours	No. of Con-sumers	Avg. Cost per Kw-hr.	Average Monthly Bills	Average Monthly Consumption Kw-hr.
1914	18	$ 24,913.00	291,000	1,859	8.55c.	$1.10	13.1
1917	77	97,516.00	1,412,500	8,334	6.90c.	$0.96	14.0
1920	109	233,819.00	3,829,900	15,665	6.00c.	$1.29	21.2
1923	142	531,505.00	11,249,100	29,689	4.72c.	$1.59	33.7
1925	170	760,364.00	21,536,100	39,117	3.53c.	$1.66	47.0
1926	174	942,309.00	29,945,632	46,900	3.15c.	$1.71	54.4

TABLE No. IV.

DATA FOR ALL MUNICIPALITIES TOTALLED

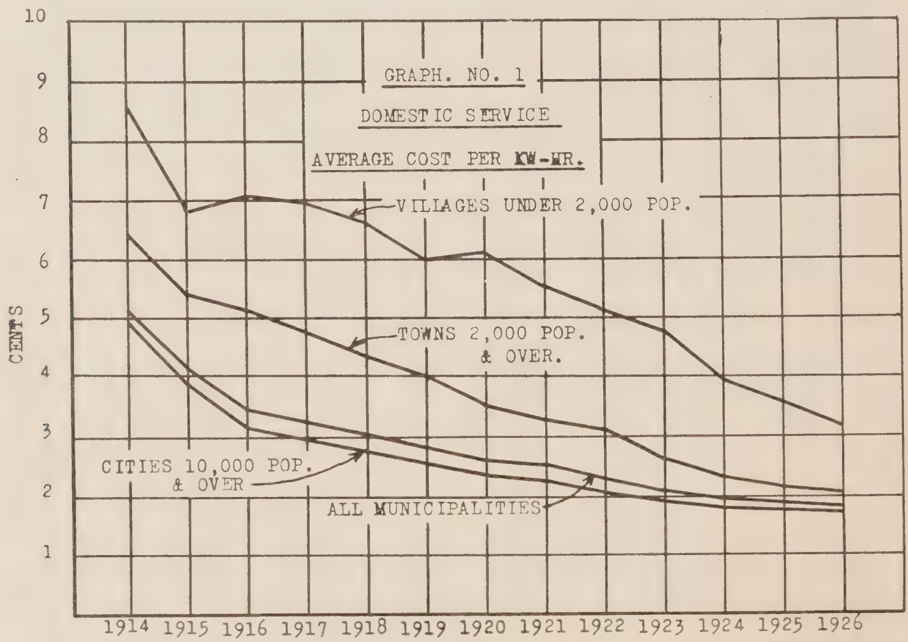
DOMESTIC SERVICE

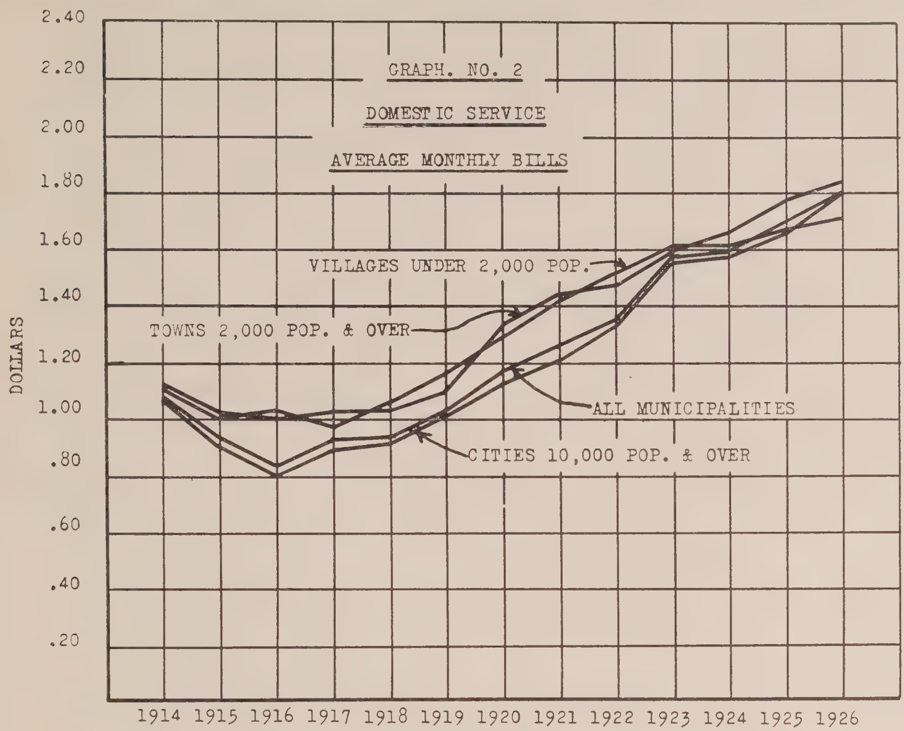
Year	No. of Munici- palities	Revenue	Kilowatt- hours	No. of Con- sumers	Avg. Cost per Kw-hr.	Average Monthly Bills	Average Monthly Consumption Kw-hr.
1914	49	$ 730,168.00	14,359,100	64,866	5.08c.	$1.06	21.0
1917	123	1,340,855.00	41,930,200	131,313	3.20c.	$0.91	28.6
1920	166	2,514,658.00	98,211,000	193,892	2.56c.	$1.15	44.6
1923	206	4,955,420.00	242,926,600	286,852	2.04c.	$1.54	75.7
1925	239	6,414,134.00	342,356,700	326,307	1.85c.	$1.67	89.6
1926	243	7,353,394.00	404,722,959	353,053	1.81c.	$1.79	98.4

Hydro Power among their consumers in furnishing this power at an average of 1.81c. per kilowatt-hour enjoyed in total an operating surplus of $1,180,000.00 during 1926 so that in reality the cost to consumers works out to less than 1.81c. when we consider their equity in the surplus thus accummulated because this surplus accrues to the benefit of the consumer and not of individual shareholders in the enterprise.

To show again in an interesting fashion, the data contained in the tables preceding are illustrated in graphic form in the following graphs:

Graph No. 1 shows the decrease in the average cost per kilowatt-hour





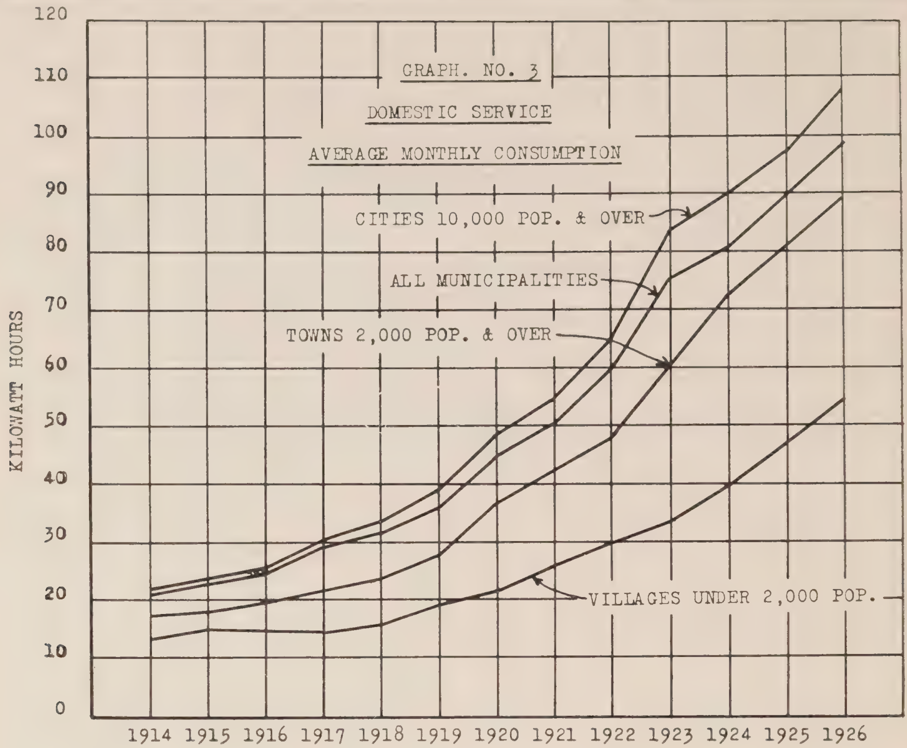
for each group of municipalities since 1914 and shows that there has been a decline in this average cost in all three groups and in total.

Graph No. 2 shows under the same groups the gradual increase in the average monthly bill. This increase is to be expected because of the increased use of electricity for Domestic purposes. Since 1916 the average monthly bill has gone up almost at a uniform rate.

Graph No. 3 shows in picture form the average monthly consumption per consumer in each of the three groups of municipalities and in all municipalities the rate of increase in consumption is perhaps a little better than the average of the two previous years and shows the necessity for serious consideration to the problem of adequate power supply.

Graph No. 4 shows the average monthly consumption in typical municipalities of the Province.

Tables Nos. V, VI, VII and VIII convey the same information as do the previous tables but for commercial lighting service and the summary, Table No. VIII, shows that here again there has been a remarkable growth in the number of consumers, and in revenue and a considerable lowering of the cost of the service. The number of municipalities increased six times; the revenue over six times, the consumption eleven times, the number of consumers four times; the average kilowatt-hour cost is 60 per cent. what it was in 1914;

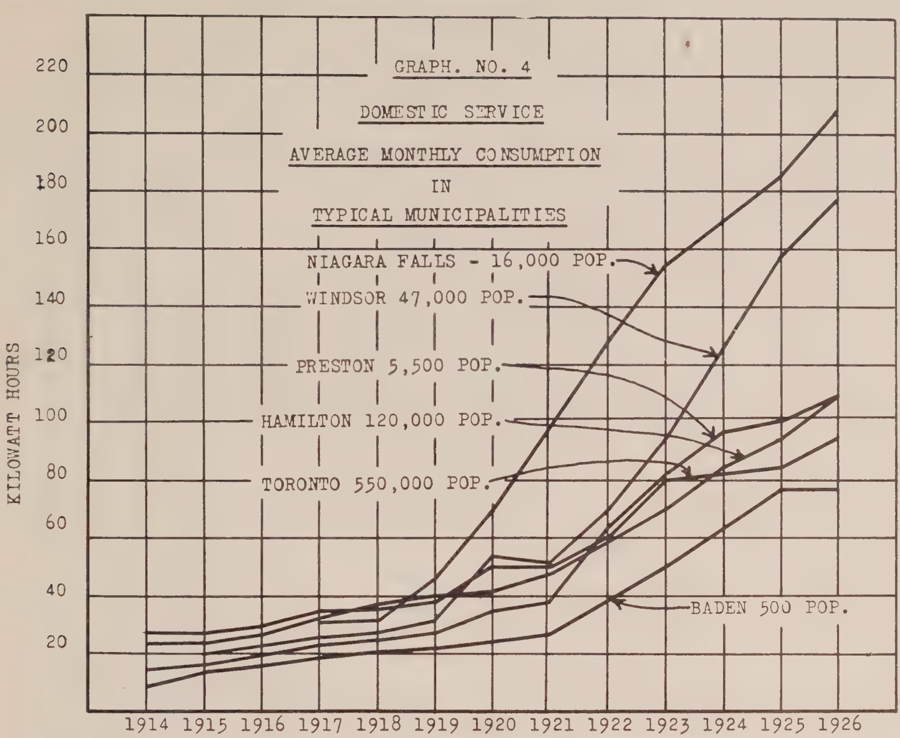


the average monthly bill has increased about 60 per cent., while the average monthly consumption has almost trebled.

During the year 1926 quite a number of revisions in the rates for commercial service went into effect whereby the cost of service is considerably less than it used to be. The full effect of these revisions will not be apparent until 1927, but it is reflected in a measure in Table No. IV., where with a considerable increase in consumption on the average there is but a slight increase in the average monthly bill. This is most apparent in Table No. VI, where it shows that with an increase of 20 per cent. in consumption there was but a 4 per cent. increase in the average monthly bill.

Graphically illustrated the statistics in the four preceding tables are shown in graphs Nos. 5, 6 and 7 showing the average cost per kilowatt-hour year by year, the average monthly bill year by year and the average monthly consumption year by year since 1914. These graphs are self explanatory.

Table No. IX, shows the cost of Power Service both Commercial and Municipal for the years 1925 and 1926. As explained in presenting the data for 1925 on account of the fact that the kilowatt-hour consumption for some power consumers in some municipalities and for Municipal Service in some other municipalities were not available, it was impossible to complete the statistics to embrace all municipalities. For the year 1926,


GRAPH. NO. 4
DOMESTIC SERVICE
AVERAGE MONTHLY CONSUMPTION
IN
TYPICAL MUNICIPALITIES
NIAGARA FALLS - 16,000 POP.
WINDSOR 47,000 POP.
PRESTON 5,500 POP.
HAMILTON 120,000 POP.
TORONTO 550,000 POP.
BADEN 500 POP.
KILOWATT HOURS
220
200
180
160
140
120
100
80
60
40
20
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926

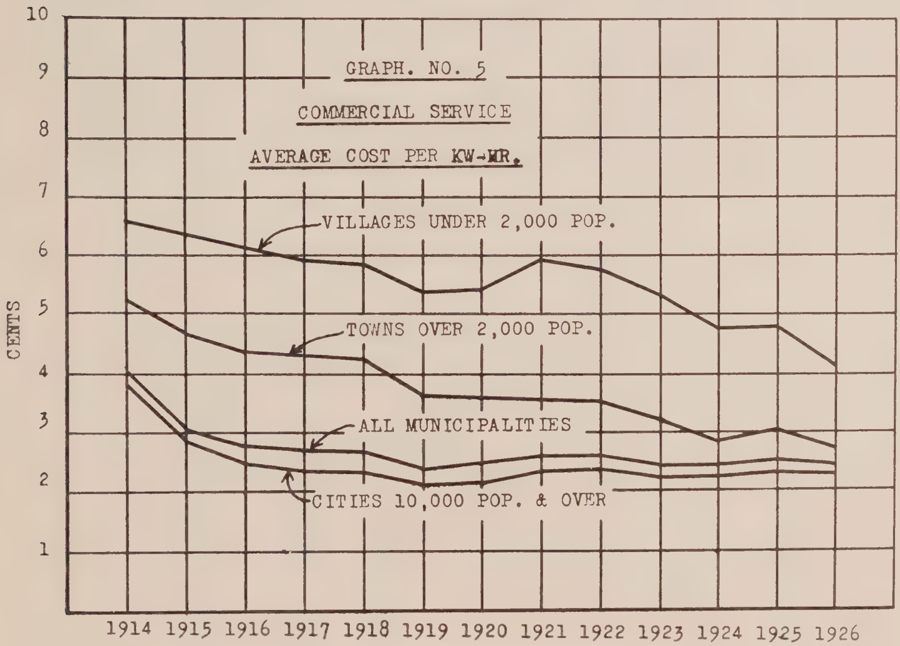

GRAPH. NO. 5
COMMERCIAL SERVICE
AVERAGE COST PER KW-HR.
VILLAGES UNDER 2,000 POP.
TOWNS OVER 2,000 POP.
ALL MUNICIPALITIES
CITIES 10,000 POP. & OVER
CENTS
10
9
8
7
6
5
4
3
2
1
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926

TABLE No. V.

DATA FOR CITIES OVER 10,000 POPULATION

COMMERCIAL SERVICE

Year	No. of Munici-palities	Revenue	Kilowatt-hours	No. of Con-sumers	Avg. Cost per Kw-hr.	Average Monthly Bills	Average Monthly Consumption Kw-hr.
1914	12	$ 536,350.00	14,048,500	12,439	3.80c.	$3.94	103.7
1917	19	642,989.00	27,479,800	19,573	2.34c.	$2.96	126.6
1920	21	1,103,599.00	50,358,000	25,505	2.19c.	$3.77	172.0
1923	21	2,043,197.00	91,146,500	32,016	2.25c.	$5.56	246.9
1925	21	3,124,526.00	131,445,500	39,074	2.38c.	$7.05	296.6
1926	21	3,393,186.00	147,581,714	40,675	2.30c.	$7.08	308.0

TABLE No. VI.

DATA FOR TOWNS OVER 2,000 POPULATION

COMMERCIAL SERVICE

Year	No. of Munici-palities	Revenue	Kilowatt-hours	No. of Con-sumers	Avg. Cost per Kw-hr.	Average Monthly Bills	Average Monthly Consumption Kw-hr.
1914	17	$ 71,457.00	1,362,000	2,393	5.25c.	$2.61	49.8
1917	27	134,730.00	3,100,600	4,107	4.35c.	$2.76	63.5
1920	36	221,867.00	6,179,400	5,736	3.59c.	$3.30	91.8
1923	43	315,530.00	9,598,000	7,086	3.29c.	$3.76	114.3
1925	48	405,089.00	13,270,300	8,048	3.05c.	$4.15	135.9
1926	48	430,467.00	15,709,616	8,310	2.74c.	$4.31	160.0

TABLE No. VII.

DATA FOR VILLAGE UNDER 2,000 POPULATION

COMMERCIAL SERVICE

Year	No. of Munici-palities	Revenue	Kilowatt-hours	No. of Con-sumers	Avg. Cost per Kw-hr.	Average Monthly Bills	Average Monthly Consumption Kw-hr.
1914	14	$16,974.00	259,200	825	6.55c.	$1.74	26.6
1917	77	82,756.00	1,403,100	3,773	5.86c.	$1.87	31.7
1920	109	152,497.00	2,799,500	5,255	5.89c.	$2.45	45.0
1923	142	254,530.00	4,738,100	7,281	4.80c.	$2.96	55.1
1925	167	327,331.00	6,839,400	8,796	4.77c.	$3.14	65.6
1926	173	352,942.00	8,505,684	9,459	4.15c.	$3.22	77.7

TABLE No. VIII.

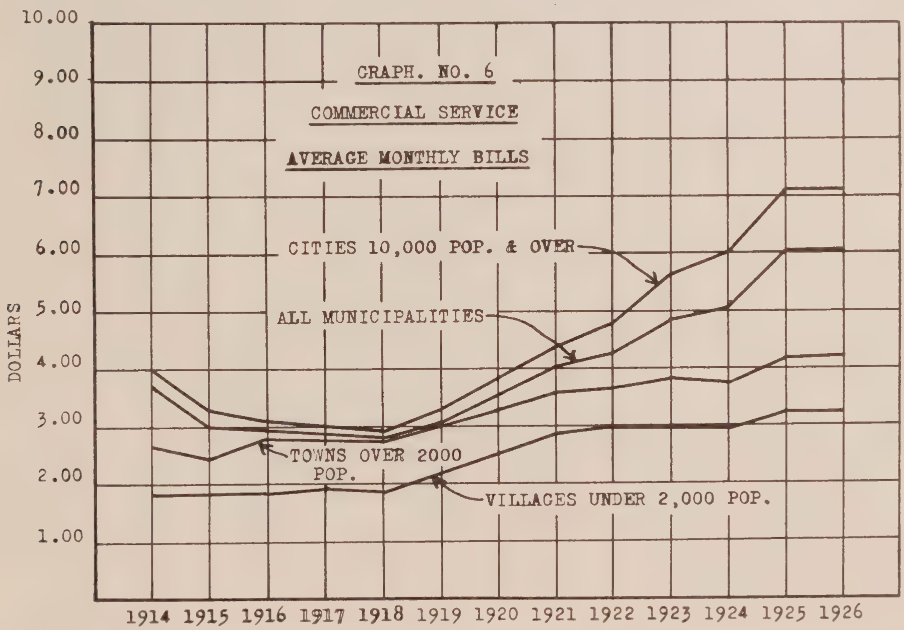
DATA FOR ALL MUNICIPALITIES

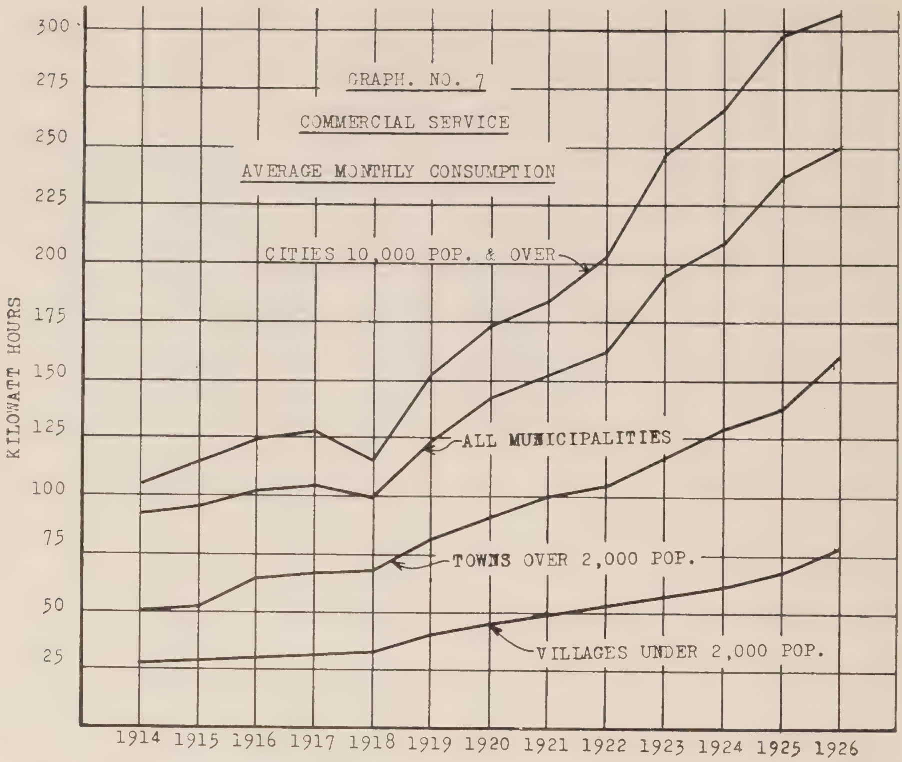
COMMERCIAL SERVICE

Year	No. of Munici-palities	Revenue	Kilowatt-hours	No. of Con-sumers	Avg. Cost per Kw-hr.	Average Monthly Bills	Average Monthly Consumption Kw-hr.
1914	43	$624,781.00	15,669,700	15,657	4.00c.	$3.63	90.8
1917	123	860,475.00	31,983,500	27,453	2.69c.	$2.77	103.1
1920	166	1,477,963.00	59,336,900	36,496	2.50c.	$3.51	140.0
1923	206	2,613,257.00	105,482,600	46,383	2.46c.	$4.80	195.6
1925	235	3,856,946.00	151,555,200	56,018	2.54c.	$5.98	235.0
1926	242	4,176,595.00	171,797,014	58,444	2.43c.	$6.08	250.0

however, practically all of the consumption of Commercial and Municipal power was obtained and with very few exceptions where flat rates are in vogue the statistics are carried to Table No. IX. In this table it is shown that the average cost per kilowatt-hour for Commercial Power has been reduced and the average cost of power for Municipal purposes has remained at 1.06c. per kilowatt-hour.

Included in the commercial power are only the power consumers being served direct by the various municipalities of the Province. The consumers served direct by the Hydro-Electric Power Commission are not





included in these statistics nor are the consumers served by the Central Ontario System nor the Rural Power Districts for which statistics are not published.

In the municipal power service are included street railways, where municipally owned, waterworks and sewerage works and any other municipal power services.

TABLE IX.

POWER SERVICE.

	No. of Municipalities	Kw-hr. Consumption	Revenue	Avg. cost per Kw-hr.
Commercial Power......	1925 — 161	440,148,260	$5,740,819.00	1.30c.
	1926 — 216	546,452,626	6,720,796.06	1.23c.
Municipal Power.......	1925 — 27	160,031,150	1,683,896.00	1.06c.
	1926 — 84	177,362,002	1,895,607.66	1.06c.

TABLE X.

STREET LIGHTING SERVICE

Year	Wattage of street lamps in use.	Assumed annual burning hrs.	Kilowatt-hour Consumption	Revenue	Avg. cost per Kw-hr.
1925	15,100,000	4100	61,910,000	$1,414,382.00	2.28c.
1926	15,114,000	4100	61,967,000	1,457,687.00	2.35c.

Table No. X, shows the cost of Street Lighting Service. As explained in presenting statistics for 1925 the cost of power for street lighting purposes may seem high in comparison to the cost of other services. We must consider the fact that in addition to supplying power to street lighting service every Municipal Hydro System in the Province maintains the street lighting equipment and provides lamp renewals out of the revenue. During the year 1926 the cost of street lighting maintenance to offset against the revenue was $300,000.00. In addition to the direct charges for maintenance and renewals there must be added something for the fixed charges on special equipment erected for street lighting purposes, equipment which corresponds to that which is erected by private consumers for domestic, commercial or power services to utilize the current. The capital for street lighting purposes is approximately $2,500,000.00 and the fixed charges and depreciation on this capital based upon the average fixed charges for all capital roughly 5 per cent. or approximately $125,000.00. Thus the actual cost of supplying power for street lighting

TABLE NO. XI.

TOTAL OF ALL SERVICES.

	1925			1926		
	Kilowatt-hours.	Revenue	Avg. Cost per Kw-hr.	Kilowatt-hours.	Revenue	Avg. Cost per kw-hr
Domestic.........	342,356,700	$ 6,414,134	1.85c.	404,722,959	$7,353,394	1.81c.
Commercial.......	151,555,200	3,856,946	2.54c.	171,797,014	4,176,595	2.43c.
Commercial Power	440,148,260	5,740,819	1.30c.	546,452,626	6,720,796	1.23c.
Municipal Power..	160,031,150	1,683,896	1.06c.	177,362,002	1,895,608	1.06c.
Street Lighting....	61,910,000	1,414,382	2.28c.	61,967,000	1,457,687	2.35c.
Total........	1,156,001,310	$19,110,177	1.66c.	1,362,301,601	$21,604,080	1.60c.

service may be considered $1,032,-687.00, producing an average cost per kilowatt-hour of 1.73c.

Table No. XI summarizes the statistics for all services for the years 1925 and 1926, and again we see how extremely low is the average cost of Hydro Power for all branches of the service.

It is a fact that if we were to include in these statistics the cost of power to large industrial users supplied direct by the Commission the average cost would be considerably less than that shown in these statistics because of the large amount of power being sold direct and of the rates in effect. A great many consumers use power for 24 hours of the day with correspondingly high consumption in kilowatt-hours and the attendant low cost per kilowatt-hour on the average. As a lot of this power is sold on the maximum demand basis without considering kilowatt-hours it is not possible to compile statistics to include this branch of the service, so that it is impossible to make the story complete at this time.

Power Per Wage Earner

In a recent issue of *Power*, Mr. F. R. Low gives a brief statement showing the effect of the use of power per capita output in various processes of manufacture. The comparisons shown are more than of interest and we give in the following an extract from his statement :

The increased productive power of human labour due to the greater use of power and to the ease with which power has been made universally applicable, by the use of the electric motor and the internal-combustion engine, has made available at reasonable prices many commodities and services that would be unthinkable without such help.

In a statement prepared for the Iowa State Board of Education, Mr. Arthur Huntington says that :

In 1890 one man produced about half a ton of coal; to-day he produces about four tons and the machinery is developed to increase this to twelve tons.

During the same period the following increase in output per worker has taken place :

From 100 sq. ft. of lumber to 750 sq. ft.

From 500 lb. of iron to 5,000 lb.

From ¼ pair of shoes to 10 pairs.

From 20 sq. ft. of paper to 20,000 sq. ft.

From 55 sq. ft. of glass to 3,000 sq. ft.

An expert nailmaker used to make 5 lb. of nails in 12 hours. The output in the nail industry to-day is 500 lb. per day of 8 hours.

Of course this gain is not all net. Human labour is necessary to make the machines that are used up in the generation, transmission and application of this power.

But it needs no argument to show that power has made and is making the work of the world easier, increasing the purchasing power of a day's work and making possible a lot of comforts, conveniences and advantages that were not imagined by our forebears.

Application of Hydro-Electric Power to Farm Work

Article No. 10

Operation of Feed Choppers

AS lines are being extended into farming districts, we are frequently asked for information as to the amount of power and the size of the motor needed and the amount of work, especially chopping, to be expected. This article is submitted with a view to giving assistance along these lines. The few facts and suggestions assembled herein are derived from the observation of results obtained in farm installations where Hydro is used.

Feed grinding is an important factor on the majority of our farms, as a great deal of the feed used is chop. The major part of grinding so far has been that of small grains only, but many farmers are now appreciating the desirability of having a chopper which, besides handling grain will also chop alfalfa and other materials. The oat-roll formerly used quite extensively is now found only on a few farms. Chop is used as feed for cattle and horses in a medium or coarse form and in a fine form for pigs and chickens.

It will be noted then that all choppers are being required to work through a range of fineness of chop, from small grains and material to quite a coarse product, such as chopping alfalfa, hay or straw.

Type of Choppers.

There are two general types of choppers found in use.

(a) The Burr with a stationary head and rotating plate. Of this type there are two distinct kinds, the floating head and the rigid head.

(b) The Hammer Type Chopper, with a set of rotating hammers attached to a cylinder shaft, the whole of which rotates inside a replaceable semi-circular screen.

When the type (a) chopper—the floating head—is running idle, the plates are held apart by an eccentric lever and depend on the grain or material to hold them apart during the chopping process. Should there be a failure of flow of grain, the plates will come together. Provision is made for solid bodies of a limited size such as nails, stones, nuts, etc., to pass through the plates. Four springs outside of the case provide for a release of the opening of the head to pass such particles.

The Rigid Head Burr differs from the Floating Head Type in that the plates are held apart, adjustment pressure being exerted against a large spring located in the centre of the stationary plate. Should stones, nails, nuts or other foreign particles enter, the spring is compressed and

permits their passage without wrecking the machine.

We find three kinds of the Hammer Type Mill in use :

1. Having fixed hard steel hammers rigidly attached to a shaft running with small clearance inside a semi-circular steel plate, which has perforations. The use of this plate controls the quality of the chop, as the material is pounded around this cylinder until the required fineness is secured, when it passes through the openings.

2. Same as No. 1, except that the ends of the hammers are split and spread, apparently with a view to increasing the area of contact with the material being pulverized.

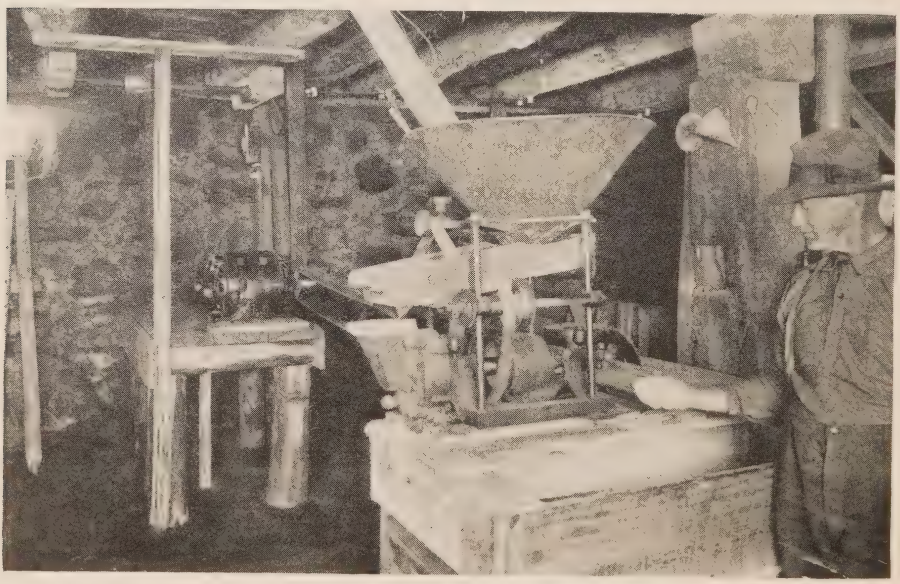
3. This type has fixed discs with bolts through them on which are hung loose hammers. These hammers have stepped faces and by centrifugal force exert a pounding action on the material being put through.

All three of these Hammer Type Choppers have replaceable screens and the proper size for the fineness of chop desired is used.

Power Requirement

Burr Choppers use plates with radially cut surfaces or corrugations and in general have a capacity of about 100 lbs. of fine chop per horsepower per hour and 150 lbs. or upwards of coarse chop per horsepower per hour.

The Hammer Type Chopper, the manufacturers claim, has a capacity of 80 to 100 lbs. per horsepower for fine chop. From reports, and from what we have noted, it would seem that the Burr Type Chopper has an average consumption on the farms of .6 to .8 kw-hr. per hundredweight,



A 3 h.p. Motor direct belted to a chopper.

whereas the Hammer Type Chopper seems to have a consumption of 1 to 1¼ kw-hr. per hundredweight.

Speed

From tests made it seems important to make sure the chopper is driven at the right speed, although a good deal depends on the condition of the machine. In general it would seem the 6½ in. Burr Type Chopper should be run at a speed not exceeding 2500 rev. per min. and an 8 in. Burr Chopper at 2000 rev. per min. when belted direct to a 3 h.p. motor. The speed of these choppers could be increased to about 3000 rev. per min. for the 6½ in. and 2500 for the 8 in. when driven by a 5 h.p. motor, but not above this speed.

Hammer Type Mills we believe should be run at a speed of 2,000 rev. per min. when driven by a 3 h.p. motor and not to exceed 2,500 when a 5 h.p. motor is used.

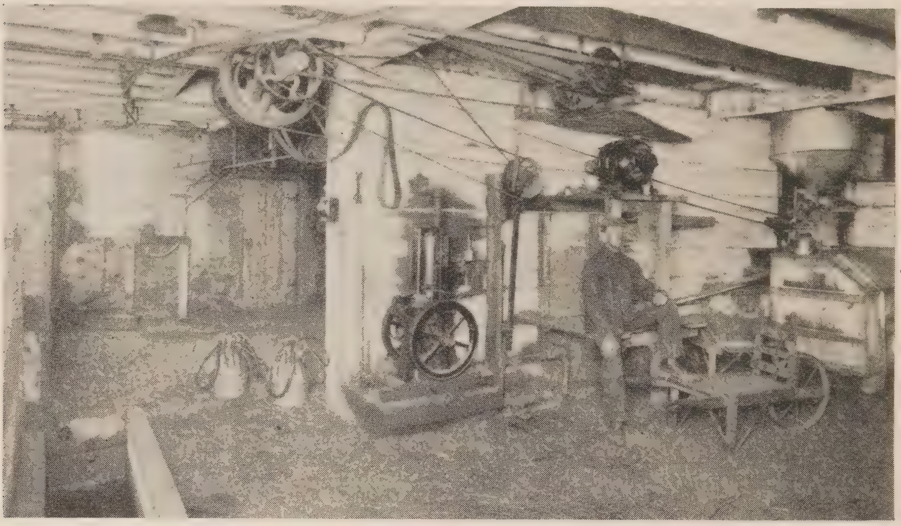
Weather conditions affect chopping capacities very greatly. From observation it would appear that in dry, crisp weather the output is considerably greater than when the weather is moist or humid. The quality ofthe grain seriously affects the capacity. When the grain is full and hard the output is high. When the grain has little starch and is mostly hull the capacity will naturally be light, as the grain will be tough, and the bulk greater per cwt. Grain cured in wet weather and harvested under bad conditions is always tough and hard to chop.

Alfalfa, hay and straw chopping is as yet done only on a few farms in Ontario. So far there has not appeared on any of the Hydro-served farms a combination which includes a Burr Chopper for this work and, therefore, all this work is done with the Hammer Type Mill. This kind of chopping should not be done at all in muggy or wet weather, but the farmer should restrict this work to crisp, cold days or to dry, bright ones.

Other Work for Choppers

The Hammer Type Mill, using the proper plate, can be used for chopping other materials, such as bones for chicken feed, making cracked wheat, or cracking other small grains if the hammers are sharp. There will be a small percentage of fine material come through when cracking the coarser grains. Some few farmers have tried chopping grain with the straw in order to avoid thrashing. This is unwise, as the bulk of material must be reduced to a fine form in order to be sure that the grain is chopped. It would be better to chop the straw coarse and to chop the grain separately. This, of course, involves thrashing.

Alfalfa, straw and hay could profitably be chopped for cattle feed, making a coarse chop. Some of the farmers of the Province have been thrashing their alfalfa in order to sell the seed. This leaves a residue in the form of a very dry material. This material has lost very little of its feed value, and if chopped even in a coarse form would reduce it to a very palatable article and, therefore, be very acceptable as good feed for cattle or horses. Should they wish to use any of this material for pig or chicken feed that part of it should be chopped



A 3 h.p. Motor belted direct to chopper, mounted on feed box.

fine. Alfalfa in this form is appreciated as a very valuable item to include in the diet of all animals and fowl.

No matter how much information should be assembled or tests made, the results would have so many variable conditions and factors that it would be difficult to reduce them all to a clear basis by which comparisons could be made and, therefore, the results we have noted and the suggestions we have made are only comparative, as what the farmers of one district consider is fine, the farmers of another district may declare as not satisfactory. Likewise the quality of the material in one district may be vastly different to that in another.

The same thing is true with reference to climatic conditions. Areas adjacent to large open bodies of water have more moist days, whereas the sections of high land located away from such bodies of water, have very crisp, bright weather conditions, which, as noted above, assist very materially in quality and quantity of output.

Farm Chopping Installations—Burr Type

The samples of "Farm Chopping Installations" submitted herein give details only of machines of the Floating Head type. The Rigid Head type of machine, with ball bearings throughout, would probably have a somewhat higher capacity, but the capacity is not the feature of superiority of this type over the other. Its particular advantage lies in the ability to maintain the quality of chop at a definite setting, with longer life of plates, and its reliability of operation, even to the extent of being able to be absent from it for short periods of time while the chopper is running. Reports reach us of plates

of the Rigid Head type lasting three or four times as long as those of the Floating Head type.

SAMPLE FARM CHOPPING INSTALLATION—BURR FLOATING HEAD TYPE, WITH 3 HORSEPOWER MOTOR DRIVE.

Mr. S. A. Davis farm—
Woodbridge, R.P.D.

Class 3 Service—Single-phase.

Total consumption and net cost for 14 months ending January 31, 1927 :

RATE

Service Charge—$3.85 per month.

Consumption Charge—5c. per kw-hr. for first 42 kw-hr. in each month. 2c. per kw-hr. for the balance taken.

Discount—10 per cent on the whole bill for prompt payment.

SET-UP

The motor is belted direct to the chopper. The chopper speed is the speed of the motor—1420 rev. per min. The chopper is an old 8 in. "Vessott", sometime referred to as a "Joliette", the name of the town in Quebec where the factory is located.

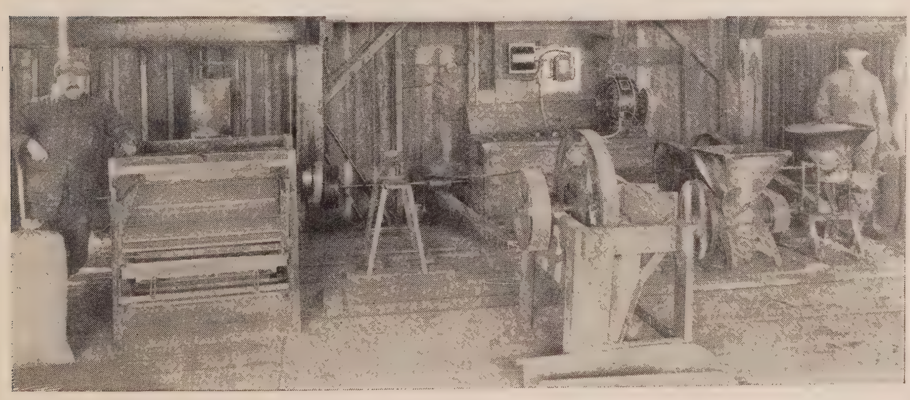
OUTPUT

The output was given to us for a four month period—Dec. 1 to March 31. It is known to be very low during the summer months and is estimated for the whole year as 260 bags or about thirteen tons.

From experience and tests on other farms we find that the power required for this work would be 144 kw-hr. The capacity, as estimated by Mr.

CONSUMPTION AND NET COST

		Kw-hr.	Cost
1 month ending	Dec. 31, 1925	23	$ 4.50
3 months "	Mar. 31, 1926	110	14.40
3 " "	June 30, 1926	52	12.74
4 " "	Oct. 31, 1926	134	19.89
3 " "	Jan. 31, 1927	151	16.52
		470	$68.05



A 5 h.p. Motor belted direct to line shafting to which is belted a chopper.

Davis, is 300 lbs. fine chop per hour, or 600 lbs. coarse chop per hour.

In addition to chopping, the motor is used for pulping roots, running grain-cleaning machine and a cutting-box.

Summary

This plant is well set up and economical to operate, as only the machinery in use is running when needed, and apparently from the records above all the uses are carefully watched.

The cost of chopping on this farm, working back from the total costs, amounts to $21.02, which is 8.08c. per hundredweight, including the proper portion of the service charge. Should the chopping be discontinued, of course the service charge would have to continue as it is.

Sample Farm Chopping Installations—Burr Floating Head Type with 5 Horsepower Motor Drive

Mr. Thos. A. Keffer—
Woodbridge R.P.D.

Class 5 Service—Three-phase.

Motor in use about nine years.

Rate

Service Charge—$4.90 per month.

Consumption Charge—5c. per kw-hr. for first 70. kw-hr. in each month. 2c. per kw.-kr. for the balance.

Discount—10 per cent. on the whole bill for prompt payment.

Total consumption and net cost for year ending October 31, 1926 :

Recorded on Domestic Service Meter	933 kw.-hr.
Recorded on Barn and Outbuilding lighting meter	258 "
Recorded on 3-phase power meter (5 h.p. motor only)	1776 "
Total	2967 "
Cost	$129.01

The work done by 5 h.p. motor for the year was (as given to us by Mr. Keffer):

Chopping of 2,000 bushels of grain.

Rolling of 800 bushels of grain.

Pulping of 1,200 bushels of roots.

Milking 15 to 18 cows twice per day all the year.

Running a cutting box for cutting hay or straw—about 60 hours.

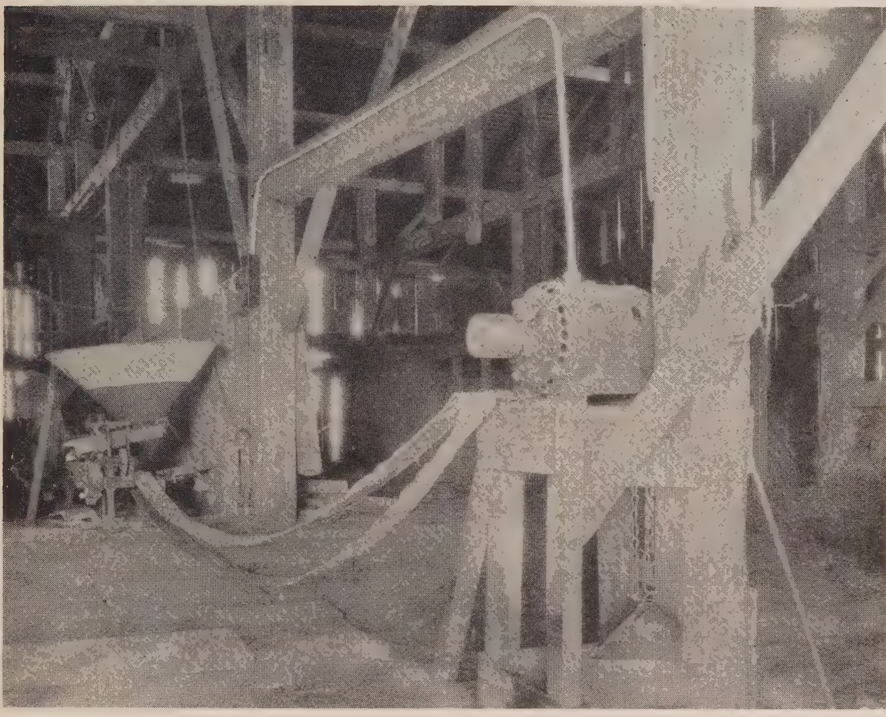
Operating a fanning mill for cleaning grain for seed or sale 5 to 6 days.

Operating a meat chopper 1 day.

Operating an elevator for handling the grain from the thresher to the granary while threshing, about two days.

The Set-Up

The assembly of machinery and method of drive on this farm is not good. The drive to chopper and oat-roll should be direct and the line shafting used only for that machinery with the lower power demand. The motor has a full load speed of 480 rev. per min. It would have been better to have a 1,500 rev. per min. motor, but since the 480 rev. per min. one is now in use, a better set-up could be made by using a proper sized pulley on the motor for the correct speed of the chopper. Change the pulley on the oat-roll to one that would give a proper speed when driving from the same pulley installed for chopper drive and drive a shorter line shafting by using a slip or collar



A 5 h.p. Motor belted direct to a chopper.

clutch of some kind on the end of the motor, having the pulley arranged to suit the clutch.

Output and Capacity

With a proper set-up driving the chopper at 2,000 rev. per min. instead of 2,460 as at present, the capacity would be greater. In fine chop it should be 500 lbs. per hour and 1,000 lbs. per hour of chop suitable for cattle and horses. At present the rolled oats is used for horses and a small amount for some cows. The capacity of the roll is about 1,000 lbs. per hour.

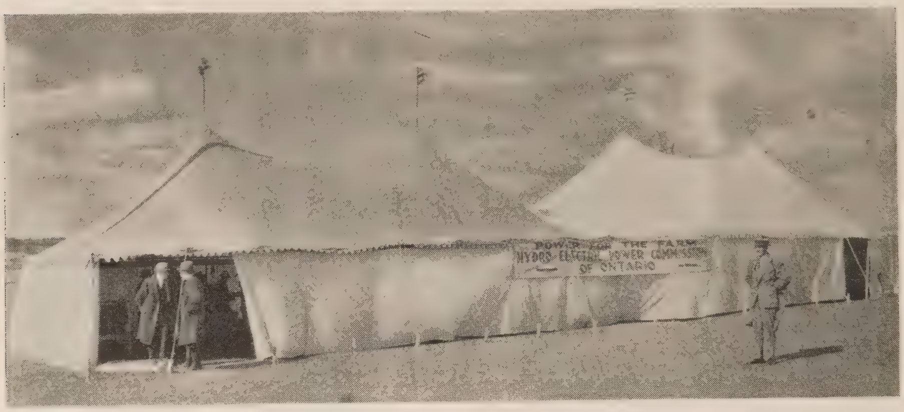
Power Uses

Of the 1,776 kw-hr. used by the 5 h.p. motor about 700 are chargeable to chopping, 100 to rolling grain, about 25 pulping roots, and the balance 976 to milking, pumping water, cleaning grain, cutting hay and straw and cutting and chopping meat.

The cost of chopping on this farm amounted to \$33.32. Assuming the total output to be 1000 hundredweight of chop and rolled feed, the cost would be 3.332c. per hundredweight, including the proper portion of the service charge, the output being delivered to the feed box in the stable below.

Hammer Type

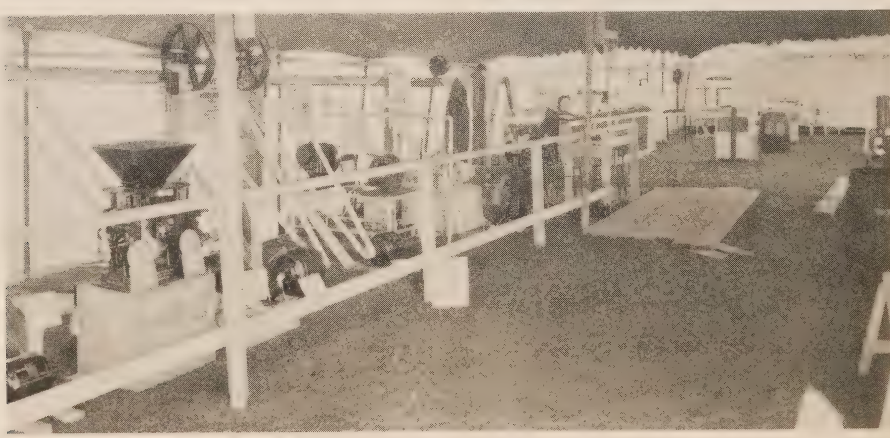
Reliable information on hammer type choppers is not yet available.



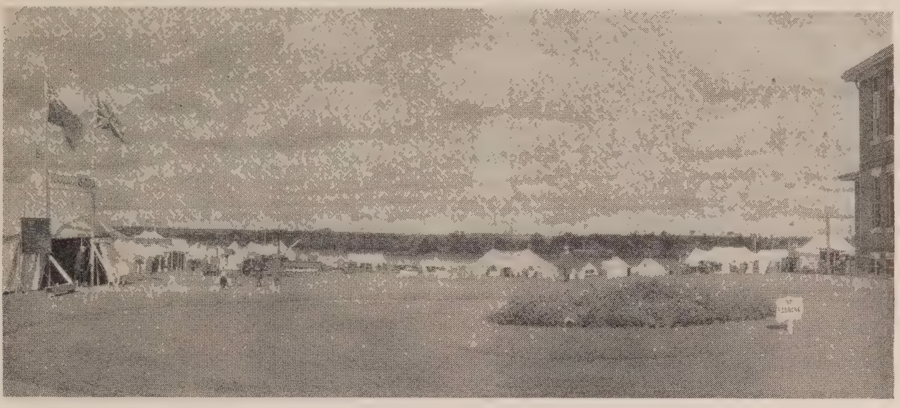
Demonstration at Provincial Ploughing Match

FOLLOWING the practice of preceding years, the Commission had a demonstration of the uses of electricity as applied to farm work at the Provincial Ploughing Match which was held October 11, 12, 13 and 14, at Langstaff, in York County. The demonstration this year was of somewhat similar nature to those previously given, being assembled in two sections, one showing electrical equipment and appliances which might be used in the home and on the farm, and the other, the application of motor drives to farm equipment in the barn and dairy.

These two sections were arranged in two large tents as shown in the illustrations; the adjacent end walls of these tents were removed so as to place both demonstrations under one cover. The exhibits themselves were very much the same as those shown in former demonstrations. The practice formerly had been to erect such



General View of Barn and Household Display.



line shafting as was necessary in the barn and dairy section on the ground. This arrangement led to the opinion that the line shafting might be set on the floor of the barn. At this demonstration the line shafting was placed as high as possible with the view to giving the impression that line shafting should be mounted on the ceiling wherever possible.

The attendance at this ploughing match was somewhat smaller than had been estimated, the reason being that weather conditions were not altogether favourable. The actual attendance, however, was estimated at about 45,000 people. Of this number, at least 50 per cent. passed through the Hydro demonstration tents. A large number of these were interested in looking for suggestions to apply either to their own farms or to those of their neighbors. Again there was a large number who came with the object of securing general information on the application of electricity to farm work and also as to the procedure in arranging for extensions to be made into new districts. In addition to the general

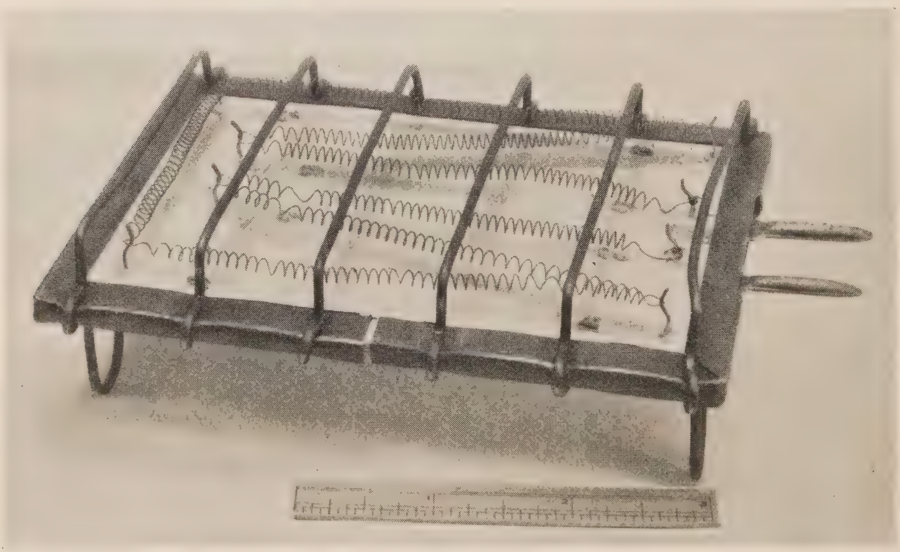
Household Display Section.

interest that was shown in the demonstration and the application of Hydro service to farm work, it was noted that most of the visitors, who were receiving Hydro service or were about to get it, were anxious that their own electric installation should be such as to assist materially in the saving of labour.

Although this demonstration was arranged by the Commission, yet considerable assistance was received from the manufacturers who loaned equipment for this purpose, and also in some cases had a member of their staff in attendance for the purpose of assisting in giving information to the public regarding the operation and use of that equipment. The assistance so rendered added considerably to the success of the demonstration and the Commission is, therefore, grateful to those manufacturers for their co-operation. It is believed that in such demonstrations, manufacturers are given an opportunity of bringing their product before the ultimate users, and that by following up such demonstrations by actual work in the field through their various agencies in Hydro-served districts, it would work materially to their advantage as well as to the farmers.

The Ten Cent Toaster

THE illustration shown on this page provides one of the strongest arguments for safety regulations respecting electrical equipment. It is a toaster which is being sold for 10 cents in the United States. As a source of fire or shock it is ideal. It will toast bread and anything else which comes its way; as for the



The Ten Cent Toaster.

shock hazard, it would appear that the designer was striving to make this the maximum. The element wires are simply wound around the terminals and a thin asbestos sheet supports them. The bars over the element can be easily bent with the fingers and the terminals are of the flimsiest construction. After a few minutes' operation the whole device becomes so hot that it cannot be touched.

This masterpiece was made in the United States and is marked "Patent pending". One is led to wonder just what feature is being patented. Possibly the efficient fire-kindling feature.

It is being distributed through chain stores in the United States.

Fortunately in Ontario the regulations forbid the sale of unapproved electrical equipment. In the States, however, there is no such legislation except in several isolated municipalities. In Portland, Ore., where legislation similar to ours exists, the distributor of this device was arrested and heavily fined, but in other parts of the States it was distributed widely.

Cases of this kind serve to emphasize the service which the Commission is rendering the people of Ontario, in shielding them from hazards created by devices of this kind. Devices are at times submitted to the Approval Laboratory, which embody serious fire or accident hazards, and the submittor is told that they cannot be sold in Ontario. The public never sees them; other localities not so protected are exposed to the hazards created by the sale of such devices.

Ontario was the first province to introduce legislation to safeguard the public in the use of electricity. British Columbia now has similar legislation, as also several cities in the United States.

In Canada, the Canadian Engineering Standards Association has, with the co-operation of the provinces, drafted a Code of Rules for electric wiring which it is hoped will be accepted all over Canada. The Commission has co-operated in this work which is of great value to the public as well as to the manufacturer of electrical equipment.

The WINTER CONVENTION of Ontario Municipal Electrical Association and Association of Municipal Electrical Utilities will be held at the King Edward Hotel, Toronto, on January 18th and 19th, 1928

Grounding Devices and Equipment

By S. W. Borden, Grounding Engineer, Crouse-Hinds Co., Newark, N. J.

(Presented at meeting of Western Section, International Association of Electrical Inspectors at Toronto, September 28, 1927).

THE terms Ground, Ground Circuit, Ground Conductor, etc., have been used rather loosely in the past, not only for safety circuits but for a great variety of other earth connections as well, including accidental and incidental grounds as well as a considerable variety of earth circuits which are used for other than safety purposes. In this latter class are the power grounds used in generating and sub-stations for grounding the neutrals of the transmission system, lightning arrester ground connections, railway return systems, earth return circuits for telephone, telegraph and other communication and signaling systems, railroad block systems, wireless equipment, etc. The insulation breaks down on a motor winding, and we call it a "ground" and we drive a rod into the ground and we call it a "ground."As you know some repair men have a rule something like this : "If you find a lighting circuit grounded, reverse the leads. This will put the ground on the grounded side and eliminate the ground."

As the interest in grounding matters has increased it has become more and more apparent that some distinction should be made in terminology between those circuits which are used primarily for safety purposes and the various other types of earth circuits and grounds, and the term "Safety Circuit" has been suggested as a practical and appropriate designation. It includes not only the circuits used for grounding at the main switch on the customer's premises, but properly includes circuits for grounding all equipment such as motor frames, hand lamps, portable tools and appliances, etc., as well as protective grounds for fire alarm and police boxes, etc.

Increase in Shock Hazards

The Safety Circuit as such was first suggested by Professor Elihu Thompson. Strange as it may seem there has been, until the last few years, very little change in safety circuit construction from that which was used during the early years of the electrical industry. This is the more astonishing when we stop to consider the fact that in the earlier days a 2,200 volt circuit was the highest we had to deal with, whereas today it is not at all uncommon to find 33,000 volt lines on the public highway and transmission systems of voltages up to 220,000 volts are now being used and these, while not on public highways, necessarily cross the highways here and there and often cross over the lower voltage systems. Furthermore the amount of current which could be drawn through a short circuit on the older systems was generally limited, due to the fact that the

transformers were much smaller and even the generating stations themselves had not the capacity to furnish as much current as is to-day taken by many individual customers. A dead ground on some of our present-day systems may mean almost anything in the way of current volume and explosive force.

Perhaps the most important change, however, is the tremendous increase in the diversity of use and in the ramifications of our present-day electrical systems. The electrical devices in use and the various applications of electricity are too numerous to mention here, but with this general adaptation of electrical service to our every-day needs in the home, office, store and factory there has necessarily come a great increase in the possibilities of electrical shock and furthermore a serious, although somewhat natural disregard upon the part of the user for the hazards involved, because familiarity often breeds contempt.

Present Conditions Not Satisfactory.

This tremendous growth and the changed conditions not only make adequate safety circuit construction imperative, but they make it increasingly difficult to obtain, because it is obvious that a circuit which might furnish adequate protection on a localized system of small capacity, such as prevailed twenty years ago, might easily be entirely inadequate under present day conditions. In spite of all these changes and while there has been a great deal of improvement in wiring methods generally, there has been, until very recently, practically no change in the construction of Safety Circuits.

It is well to note that State Labor Bureaus and Industrial Commissions are beginning to take serious notice of the shock hazard in industry, and are beginning to formulate regulations of their own, as they feel that the existing codes or at least the results that they are obtaining from the existing codes, do not furnish sufficient protection, and this is not to be wondered at when it is possible for three men to be killed in as many minutes from a single portable machine, as recently happened in New Jersey. Such accidents can undoubtedly be prevented by proper safety circuit construction. In at least one instance an effort has been made to put through legislation which would make some one criminally liable for inadequate protection.

The Code is being Changed

During the past four or five years there has been an awakened interest in this problem. One contributing factor is the fact that the National Electrical Code, now that it has become an American Engineering Standard, is undergoing a fundamental change in character, and is being made over into an all hazard code, as it can no longer be merely a fire underwriters' code, and this means, of course, that it must provide for proper construction to take care of the shock hazard as well as the fire hazard. As you all know the grounding section of the code has been considerably strengthened in the last two revisions. The activities of the

Labor and Industrial Boards have had their influence, but perhaps the strongest influence has been that of the Electrical Codes of some of our large cities. These codes are, naturally, all hazard codes, since the Municipality is as much concerned with the shock hazard as with the fire hazard, and some of the code work which has been done is certainly setting a pretty stiff pace for the National Electrical Code. The new Canadian Code also is an outstanding example of this class of code work.

General Safety Circuit Requirements.

The Safety Circuit, for the ordinary lighting installation, should have the following characteristics :

(1) It should create no fire hazard in itself.

(2) The connections should be so arranged that when a burn-out occurs, due to one of the ungrounded service wires coming in contact with the service entrance conduit, the ground connection for the conduit itself will not be injured.

(3) The circuit should provide a proper path for both high and low frequency currents, and also for direct current.

(4) The circuit should have as low resistance and impedance, and as high carrying capacity as a reasonable cost will permit.

(5) It should be fully protected against mechanical injury.

(6) All connections should be at least as good as those employed for other electrical circuits, and must have ample carrying capacity.

(7) The construction should be such that its application need not be limited to any particular locality or conditions.

(8) The construction should conform to the requirements of the National Electrical Code.

In the Safety Circuit shown in Fig. 1, all of these figures are provided for as follows :

1. In case one of the ungrounded wires becomes grounded on the service entrance conduit the resulting short circuit current is confined within the switch box itself, and therefore creates no fire hazard. An open ground wire may be a serious fire hazard.

2. If the resulting short circuit destroys the conductor or the ground connections through which it passes, the ground connections for the switch box and conduits still remain intact, so that the protection against the high voltage hazard is not destroyed.

3. Two paths to ground are provided, one of which (the conduit) will readily drain off high frequency disturbances, while the copper conductor, in multiple with the conduit, will have sufficient carrying capacity and sufficiently low resistance to prevent any interference with the operation of the primary fuses or circuit-breakers, or even a trolly circuit-breaker set for 3,500 amperes. No other combination of half-inch conduit and No. 8 wire will do this, and trolley crosses are generally more or less disastrous where other systems are used.

4. Two conductors in multiple provide a reasonable safety factor since

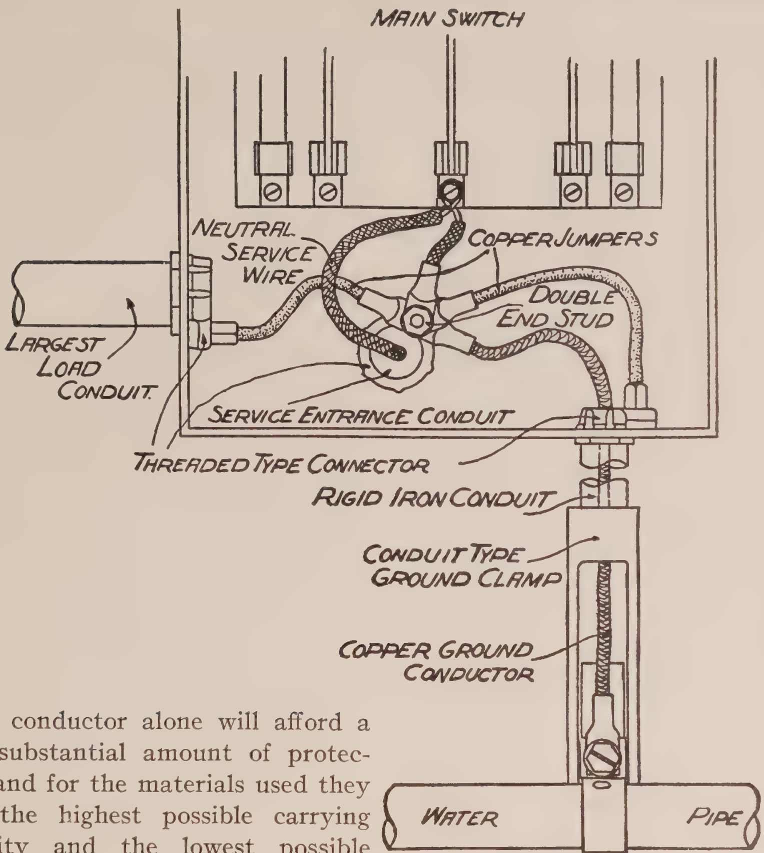


Fig. 1

either conductor alone will afford a very substantial amount of protection, and for the materials used they give the highest possible carrying capacity and the lowest possible resistance.

5. The ground clamp and ground wire are properly protected from mechanical injury as required by the National Electric Code, Section 905 D. (1925 Edition).

6. No dependence is placed upon the locknut-bushing-box type of contact, as these are unreliable, especially where enamelled boxes are used or corrosive conditions exist.

7. The system is suitable generally for standardization, and it may be properly used where artificial grounds are employed as well as where water piping is available. With the system built up according to these specifications even a poor artificial ground will afford considerable protection against the life hazard, while the fire hazard is well taken care of.

8. It violates, in no way, the National Electric Code.

There are at present in use in the neighbourhood of one hundred and fifty thousand safety circuits which conform to the type shown, at least to the extent of employing a conduit type ground fitting, grounding bushings and conduit protection all the way from the box to the water pipe. They are widely distributed over the

country, thus demonstrating its universal applicability so far as territorial requirements are concerned.

Point of Connection of Safety Circuit to Water Pipe.

I will not take the time here to go into the pros and cons of making the safety circuit connection on the street side of the water meter, except to say that there is a very strong tendency toward permitting the connection to be made to the nearest point of the permanent cold water system, and this seems to be fully justified, providing the meter is properly shunted.

Perhaps one thing which has tended to keep the connection on the street side of the water meter has been the fact that the shunting of the meter has been too often carried out by means of ordinary ground clamps and a copper jumper wire, without any mechanical protection being given to this equipment, with the result that the shunts have been very short-lived. With the present code requirements both of the ground clamps and the jumper itself must be enclosed for mechanical protection, and the conductor properly supported where support is needed, unless a factory made shunt, so designed as to be self-supporting and self-protecting against mechanical injury is employed. There are several-makes of shunts now on the market, but so far as I know but one of these has been approved by the Laboratories as being self-supporting and self-protecting, an approved type of shunt, properly installed, is shown in Fig. 2.

Grounding Fittings.

There are three types of grounding fittings, which I would like to mention briefly. The conduit type of ground clamp, the grounding bushing, and the rigid base, open wire or meter shunt fitting.

The Conduit Type Ground Clamp, as its name implies, is designed to accommodate not only a copper conductor but also the end of a conduit used for protecting the conductor, thus affording complete mechanical protection, and at the same time connecting both the conduit and the conductor to the water pipe. These fittings employ a flexible strap for the attachment to the pipe, although it is recognized that the best method of connecting to a pipe is by means of a threaded type connector. Fittings of the threaded type are available, but the practical difficulties involved in having fittings of the sort installed in water lines ahead of the shut-off valve has generally precluded their use. The strap connector, however, when properly *designed* and *installed* on a *galvanized* pipe gives very satisfactory service, but care must be exercised with respect to all of these features. In actual practice the strap must be capable of fitting a very

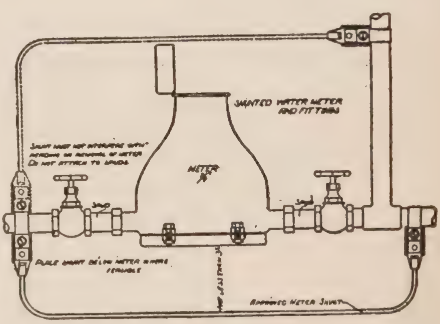


Fig. 2

large number of different outside diameters. There are all the iron pipe sizes to be fitted, and all of the lead pipe sizes with three different thicknesses in each size, to say nothing of ground rods. There are in fact something over 40 different outside diameters for sizes below 2 in. pipes. If a strap is designed for iron pipe, trouble is liable to be encountered in using it on lead pipe, and if designed for lead pipe, there may be trouble in using it on iron pipes, and neither one may fit a ground rod. However, there are now available complete lines of fittings equipped with straps punched for iron pipe sizes, a complete line, having a reversible strap one end of which is punched for iron and the other for lead pipe, and a third line of fittings equipped with a strap which fits all outside diameters. This latter line of fittings is equipped with two clamping bolts and a strap 1 in. wide, and may be relied upon to make good contact even on rough or distorted surfaces.

The conduit type of ground clamp is available in several styles, namely, the one piece fitting, the two piece fitting, and the swivel fitting. The one piece fitting is naturally the cheapest, but not so convenient to install. In the swivel type the fitting is broken in the middle so that the conduit end may be turned in any direction, while in the two piece swivel type the portion which attaches to the water pipe may be separated entirely from the portion which is attached to the conduit, thus providing greater convenience in installation. In fittings of this type, however, care must be taken to see that the contacts at the swivel are entirely adequate, since this fitting is installed in a conduit which is generally used as a ground conductor, and one which is liable to be subject to very heavy currents.

Grounding Bushings :

When it is desired to connect a conductor to a conduit, which terminates in a box there is no more effective or workmanlike way of making this connection than to make it to a bushing in the box itself, because the bushing being threaded on the conduit affords an electrical contact with the conduit which is better than can usually be obtained by other than threaded means, especially in the case of enamelled conduit, and the jumper being inside the box improves the appearance of the job generally and eliminates any fire hazard should the ground circuit become overheated. It is essential, however, that the bushing be tight on the conduit. Such bushings necessarily have some means of attaching the conductor, and as they have to be manipulated in a rather limited space the bushings are liable to be left at that point of the last turn, where it is the most convenient to make up the connection, and that point may not be the point where the bushing is tight, and it is therefore very desirable that grounding bushings should be so designed that they are automatically tightened up and locked on the conduit when the connection to the bushing is completed. This automatic locking feature is inherent in at least one type of bushing now available.

Meter Shunt and Open Wire Fittings :

This type of fitting should be designed with a rigid base, the base being clamped directly against the water pipe and the construction in general should be such that any strain which is put upon the conductor can not be transmitted to the clamping members in such a way as to loosen the connections. The base should preferably be of copper or brass so that the conductor may be soldered directly into it.

Solderless Connections :

There seems to be some little sentiment in favour of the use of some solderless method of attaching the ground conductor to the grounding fitting, but the demand has not been sufficient to produce any great activity along those lines. The Underwriters' Laboratories requirements for this type of connection are pretty severe, and while I would not recommend lowering the standard in this respect, nevertheless it perhaps would be pointed out that ground conductors are often called upon to carry currents of sufficient magnitude to melt the ordinary solder connections. If there is any real demand for this type of connection there is no doubt that it can be and would be made available to the trade, and I am pretty anxious to know the sentiment of the inspection departments generally in this respect.

Artificial Grounds.

I think it is pretty generally agreed that the code situation, with respect to Artificial Grounds, is not entirely satisfactory in that it has not resulted in uniform practice with respect to the installation of artificial grounds, nor is it generally producing grounds of reasonably low resistance. Some recent suggestions in this connection I think are well worth considering. The idea is this. Whenever an artificial ground is necessary in connection with the customers wiring the customer should be required to drive two rods or pipes, the rods being alike and driven to the same depth and spaced six feet apart, this being done along with the rough wiring. When the contractor makes application for inspection for the rough wiring he should be required to stipulate on his application, the measured resistance of the two rods in series. When he finishes up the job he connects the two rods in multiple and to the system, and so far as he and the owner are concerned their part is done, and they have no further obligation with respect to the resistance of the artificial ground. The inspector may check the ground resistance when he inspects the rough wiring, although after a reasonable amount of experience and accumulated data he will be able to judge quite accurately whether or not the contractor's report is correct.

If the resistance is above a prescribed limit the inspector should notify the Public Utility furnishing the service, and it is then incumbent upon the party furnishing the service to provide grounding facilities at the transformer, or to otherwise bring the resistance down within proper limits and the inspector should refuse to issue his final certificate until that has been done. This additional grounding naturally would be done by the utility, and at its own expense,

and the inspector might reasonably require that he be notified when it has been done and given a record of the utilities test, which he may or may not check, as his judgment dictates.

It is suggested that the resistance to ground from a grounded circuit wire be not more than 25 ohms, and that the resistance between the two electrodes installed on the customer's premises should not exceed 100 ohms. There is a definite relation between the resistance of the two electrodes in series and the same two electrodes when they are connected in multiple, and with a series resistance of 100 ohms the multiple resistance would seldom exceed 25 ohms, and in no case would it exceed 31 ohms.

It will be seen that this procedure would necessitate the contractor measuring the resistance of the two driven rods in series, but this is a very simple matter, requiring but a few minutes' time, as there are available on the market light, inexpensive portable, direct reading meters, for that purpose. It should be noted that the necessity for making the resistance measurement only arises in those installations where water systems are not available for grounding, and even then it would be necessary to make the tests only when the first installation is connected to a transformer. In actual practice, however, it probably would work out better to require the test for all artificial grounds, if for no other reason than for the sake of the information which would be accumulated as to the resistance characteristics of the soil in different parts of the territory.

It looks as though this arrangement might be feasible, and would have several decided advantages. In the first place the contractor and the owner would know definitely what they have to do and how they have to do it, and the inspector and the utility would know just what they have done, in the way of ground resistance, and there would be reasonable assurance that the neutral of every transformer would not show more than 25 ohms to ground, and the point where the customers' expense stops and the public utility's begins would be clearly defined.

The Notch

The picture on the front cover of this issue is of a unique geological formation. Dr. Coleman, geologist, says he thinks that at one time the Montreal River flowed more directly into Lake Temiskaming but had become blocked by some change in the earth's crust. It had therefore to cut a new course using the opening shown which was caused apparently by an opening of the rock,

Re Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.—*Editor*

Hydro News Items

Central Ontario System

The Canadian International Films Ltd., is arranging for a supply of between 300 and 400 horse-power at Trenton in connection with the production of a series of screen pictures.

* * * *

The construction of a new 44,000 volt line from Trenton to Port Hope is now under consideration.

* * * *

Approval has been given for the construction of 2½ miles of line in the Township of Darlington near Bowmanville to feed the new radio station of Messrs. Gooderham & Worts.

* * * *

A meeting of the Central Ontario Power Association held at Cobourg passed resolutions commending the Hydro-Electric Power Commission of Ontario for its administration of the Central Ontario System and empowered its Executive Committee to consult with the Ontario Government.

Niagara System

The distribution system in Embro has been overhauled recently and a large amount of additional copper added to the lighting secondaries to take care of the increased load due to the use of larger electrical appliances.

The distributing station has also been increased, its present capacity being 225 kv-a.

* * * *

During this month the Shedden 150 kv-a. 13,200/4,000 volt distributing station was placed in service to supply consumers in the western part of St. Thomas Rural Power District.

* * * *

The distributing station at Ridgetown has been increased from 450 to 750 kv-a. The rural load served from this point is showing rapid growth.

* * * *

Owing to increased load on account of service to electric ranges, the distribution system in Brigden is being rebuilt, larger copper being strung and transformers of greater capacity being installed.

* * * *

The distribution system in Watford has been completely rebuilt, copper and transformer capacities having been increased to take care of the growth of domestic load.

* * * *

The town of Bothwell has placed in operation twenty-six ornamental street lighting standards, using 300-watt multiple lamps.

* * * *

A 4,000-volt line, fourteen miles long, is being constructed in Thames-

ville Rural Power District to supply the village of Florence, the hamlet of Kent Bridge, and farm services along the route.

The St. Lawrence System

A rural extension is being constructed from north of Chesterville to Berwick, to supply residents of Winchester, Finch Townships.

* * * *

The Commission has approved of the construction of a 4,000 volt, single phase line from Chesterville sub-station to the village of Finch, to supply 25 h.p. to Finch.

* * * *

Rural residents in Williamsburg township are to receive service from a line under construction from Williamsburg.

Association of Municipal Electrical Utilities

NOMINATIONS FOR OFFICERS FOR 1928

The scrutineers appointed for the purpose of counting the ballots for the election of officers for the year 1928 report the following results, showing the nominations according to the primary ballot which has recently been returned :

PRESIDENT : Messrs. *J. G. Archibald, *J. J. Heeg, W. E. Reesor, E. V. Buchanan.

VICE-PRESIDENT : Messrs. *W. R. Catton, *A. W. J. Stewart, R. L. Dobbin, R. J. Smith, J. G. Jackson, J. E. Teckoe, V. S. McIntyre, W. E. Reesor, O. M. Perry, T. W. Brackinreid, J. G. Archibald, O. H. Scott, C. T. Barnes, E. V. Buchanan, C. E. Schwenger, D. B. McColl, J. E. B. Phelps.

SECRETARY : *Mr. S. R. A. Clement.

TREASURER : *Mr. D. J. McAuley.

DIRECTORS (*from Membership at Large*): Messrs. *O. H. Scott, *V. S. McIntyre, *E. V. Buchanan, *J. E. B. Phelps, *J. G. Jackson, W. R. Catton, *O. M. Perry, R. H. Starr, E. J. Stapleton, T. W. Brackinreid, R. J. Smith, P. B. Yates, C. T. Barnes, J. W. Bayliss, R. L. Dobbin, J. J. Heeg, E. M. Ashworth, E. I. Sifton, A. O. Hunt, C. A. Waters, C. E. Kirkby. W. H. Childs, H. F. Shearer, A. H. R. Thomas, C. E. Schwenger, Chas. H. Denton, J. E. Teckoe, R. H. Martindale, J. E. Skidmore, J. M. Stalker, H. G. Hall, J. T. Park, R. M. Young, W. H. Gurney, C. C. Folger, Dr. J. A. Anderson, G. E. Chase.

DISTRICT DIRECTORS :

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*These names to appear on the election ballot, which will be submitted at the January Convention.

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in October, 1927.

Devices

THE BRANTFORD OVEN & RACK CO. LIMITED, Brantford, Ont.

Electric pastry oven, four deck.

* * * *

CANADA VULCANIZER AND EQUIPMENT CO. LIMITED, 88 York St., London, Ont.

Electrically-illuminated gasolene pumps and visible measuring tanks. Types 407 and 507. "Canada Vulcanizer and Equipment Co. Ltd."

* * * *

CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ont.

Polyphase Linestart Type HS induction motors.

* * * *

ELECTRO-MAGNETIC TOOL COMPANY, Cicero, Ill.

Portable electrically-driven drills and screw drivers. Drills, Cat. Nos. 82, 83, and 84; screw drivers, Cat. Nos. 153 and 154.

* * * *

THE PERFECLITE COMPANY, East 40th and Superior Avenues, Cleveland, Ohio.

Portable or stationary reflector type electric spotlights, known as "Swivelite Reflectors" Nos. 109 and 111.

* * * *

WILSON ILLUMINATION COMPANY, LIMITED.

Stationary reflector type electric spotlights.

Marking: "Pittsburgh", 'Pittsburgh Reflector Co.

THE FRANK E. WOLCOTT MANUFACTURING CO., Hartford, Conn.

"Torrid" Upright Toasters, Cat. Nos. 601 and 602.

Coffee percolator heater and coffee filters, Cat. Nos. 350, 225 and 226.

* * * *

*CAPITOL MACHINE CO., INC., 100 E. 42nd Street, New York, N.Y.

Capitol motor-operated motion picture projector, portable type, Model A.

Marking: Nameplate with manufacturer's name, rating, together with the wording "For use with slow-burning film only."

* * * *

*SPENCER LENS CO., 19 Doat St., Buffalo, N.Y.

Portable still picture projectors of the non-professional type. "Delineascopes": hand-operated Model I, Model M; motor-driven, Model L.

Fittings

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, 224 Wallace Ave., Toronto.

Enclosed branch circuit cutouts.

Marking: Manufacturer's name on nameplate.

* * * *

SQUARE D COMPANY, Walkerville, Ont.

Sheet metal cabinets.

* * * *

*CIRCLE F MFG. CO., Trenton, N.J.

Medium base receptacles (As listed on Underwriters' Laboratories card dated May 17, 1927).

Switches

OTIS-FENSOM ELEVATOR COMPANY, Ltd., Hamilton, Ont.

Elevator door switch.

Marking: Nameplate with name of manufacturer and the rating.

* * * *

*CIRCLE F MFG. CO., Trenton, N.J.

Flush Switches.

Push Type. Single-pole, Cat. No. 3001; three-way, Cat. No. 3003.

Toggle type. Single-pole, Cat. No. 3101; three-way, Cat. No. 3103.

* * * *

*WESTINGHOUSE ELECTRIC & MFG. CO. (Submittor), East Springfield Works, Springfield, Mass.

CANADIAN WESTINGHOUSE COMPANY, LIMITED (Agent), Hamilton, Ont.

Motor-control Switch. Style Nos. 416896, 416940, 452957, 452958-A, 452959, 452960, 494726, 495367.

Portable Lighting Devices

THE DE LUXE UPHOLSTERING COMPANY, LIMITED (Art and Novelty Department) 117 King St. West, Kitchener, Ont.

Portable electric lamps.

Miscellaneous

*CRESCENT ARMORED WIRE CO., INC., Trenton, N.J.

Armored Cable.

Marking: Small crescent and star stamped on armor at intervals of approximately 1½ in., or red and green threads underneath the armor and parallel to the conductors, or green and red threads crossing in outer braid of twisted conductors.

* * * *

*CRESCENT ARMORED WIRE CO., Taylor and Olden Sts., Trenton, N.J.

Flexible Steel Conduit.

Marking: A crescent and a star stamped in outer surface at intervals of approximately $1\frac{5}{8}$ in.

* * * *

*CRESCENT INSULATED WIRE AND CABLE CO., THE, INC., Trenton, N.J.

Rubber-covered Wire.

Marking: Red and blue threads crossing in braid, or red and green threads crossing in braid, or one blue and one red thread under the braid parallel to the conductor.

Rubber-covered fixture wire.

Marking: Red and green threads cabled with copper strands.

Flexible Cord.

Marking: Red and green threads cabled with copper strands.

* * * *

*DALYTE ELECTRIC, LIMITED, Guelph, Ont.

Flexible tubing.

Marking: A red and brown twisted thread or an uncolored cotton thread interwoven longitudinally and appearing dotted on the inside of the tubing.

* * * *

*L & N. CO., THE, LTD., St. Johns, Quebec.

"Loomex." A non-metallic sheathed cable consisting of two copper conductors having rubber insulators and a protective covering consisting of a combination braid of paper cords and cotton threads, and a layer of helically-wound paper tapes.

Marking: One orange thread in inner braid.

* * * *

*These devices are under Underwriters' Laboratories re-examination or label service.

THE BULLETIN

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Paugan Falls Development

(The details used in this description, as also the illustrations, were supplied by Mr. R. F. Howard, Manager of Power Sales, Gatineau Power Company, Ottawa, to whom "The Bulletin" is indebted).

THE Paugan Falls Development now under construction on the Gatineau River is being made primarily for the purpose of supplying the bulk of the 25-cycle power to be delivered to the Commission by the Gatineau Power Company under an agreement made last year. This agreement calls for the delivery of a total of 230,000 to 260,000 h.p. commencing with a block of 80,000 h.p. to be delivered in the year 1928.

The construction of the Paugan Falls plant was commenced in the fall of 1926. It was found that the most economic location for the plant was to build the main dam along the rocky ridge on the west side of the river, the dam crossing the main channel of the river about 200 ft. below the actual Paugan Falls. This is illustrated in Fig. 1 which is a down stream side view of the power house under construction, shown at the right side of the picture, and the west end of the main dam, also in Fig. 2 which shows the up stream side of the main dam. One of the first steps was to provide for the passing of the flood during construction. With this end in view a by-pass was cut through this rocky ridge, capable of passing 30,000 cu. ft. per second. The outlet of this by-pass is seen at the left of Fig. 1. A close-up view of the cut for the by-pass near the main dam is shown in Fig. 3. This illustration also shows the location of the power house in reference to the main dam, construction for the power house being seen at the right of the picture. On the top of this ridge are constructed part of the dam and penstock openings. The power house is located about 200 ft. below the dam, the east end of it

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December, 1927

abutting on the east side of the original river channel. The power house and gate house will therefore be in separate buildings, which are constructed of structural steel and red brick.

The power house is being constructed to accommodate eight generating units, 6 of which will be installed immediately. Each water wheel develops 34,000 h.p. at a speed of 125 rev. per min., using 2500 second feet of water under a head of 140 ft. They are of the single runner, Francis type, with Moody spreading draft tube and spiral rivetted plate steel scroll case. There will be a central governor pumping system consisting of two motor-driven and one water wheel driven centrifugal pumps. The governor fly balls are motor driven.

Water will be supplied to each unit through a 17 ft. average diameter steel penstock, which will be encased in concrete. There will be two fixed roller type head gates at the intake of each unit, and one set of steel emergency gates which can be lowered in front of the head gates of any unit. Six additional intake openings are being left in the dam to provide for future extension.

The generators will be 28,500 kv-a. each and generate 25-cycle power at 6600 volts, and are being built with

Fig. 1—Down-stream side of Power House and west end of Main Dam. The outlet of the By-Pass carrying the total flow of the river is shown at the left.

Fig. 2—Up-stream side of Main Dam from east end. The cut for the By-Pass seen at the farther end.

characteristics suitable for the 200 mile transmission line to Toronto. Direct connected to each generator will be an auxiliary generator of 300 kv-a. capacity excited by a direct connected 21 kw. d.c. generator. The auxiliary generator will drive a motor generator set of 185 kw. capacity for exciting the main generator. The voltage regulators will be of the Niagara, rheostatic type especially adapted to high speed excitation. Duplicate centrifugal pumps will supply oil for generator bearing lubrication. The fly wheel effect of the generator rotor will be 24,000,000 pounds feet squared.

Power will be transformed from 6600 to 220,000 volts. The transformers will be single-phase units, each bank consisting of 3-19,000 kv-a. units. The transformers will be oil insulated, water cooled, outdoor, core type, delta connected on the low-tension side and star connected on the high-tension side, with neutral solidly grounded. Two generators, two low-tension switches and one transformer bank will form a complete unit. All generators and auxiliaries in the power house will be operated from the control room located adjacent to the generator room. The low-tension switching will be used for synchronizing and unit protection only.

The high-tension switching station will be outdoor type construction having a double bus. It will cover an area of 400 x 400 ft. located 3,000 ft. from the power house. All outdoor breakers and disconnects will be controlled from a relay house adjacent to the switching station.

About one-half mile to the east of the main dam, located in a gulley, is

Fig. 3—Down-stream side of west end of Main Dam, showing By-Pass and end view of Power House.

the spillway dam which is illustrated in Fig. 4. Here the river will be controlled by six steel sluice gates, each 50 ft. wide, and operating under a maximum head of about 33 ft. At the west end of the spillway dam there will be built a concrete log slide.

The approximate quantities of the main items of the Paugan Falls construction are 220,000 cu. yds. of concrete, and about 210,000 cu. yds., of rock including the cut-offs. There are three cut-offs necessary, two on the west side and one on the east side. The head pond of this development will have an area of approximately 17 sq. miles and will extend up stream a distance of about 45 miles to the tail-race of the proposed Maniwaki development.

The Paugan Falls development is the third under construction on the Gatineau River by the Gatineau Power Company, the other two being that at Farmers Rapids and at Chelsea, to which we have made reference in the October Bulletin. When the proposed Maniwaki development has been completed it is interesting to note that with a flow of 9,000 cu. ft. per second, the total drop in the river between the head pond at Maniwaki and the tail-race at Farmers Rapids amounts to 383.3 ft. Of this total the head used at the four plants will amount to 375.1 ft. so that what might be called a loss in head in this stretch of the river of 75 miles is only 8.2 ft.

Naturally, these large installations could not be made without an efficient control of the stream flow. This is now partially accomplished by the Baskatong Storage Works located some 32 miles above Maniwaki.

Surveys were started for this work in September, 1925 ; construction started in November 1925, and completed by April, 1927. The main dam was located in the Gatineau River at the Bitobi Rapids some 12 miles below the junction of the Gatineau and Gens de Terre and 32 miles North of Maniwaki rail head. The previous water area of the existing reservoir amounted to some 19 square miles, consisting of river bed and Baskatong Lake. The present water area with full reservoir is some 115 square miles. The drainage area to the dam is 6300 square miles and the total storage capacity is approximately 100 billion cubic feet. Based on previous records, this will alone insure a dependable flow in excess of 9,200 cu. ft., per sec., in all but the extreme lowest year, and in the lowest year a flow of something over 8,000 cu. ft., per sec., could have been maintained, whereas the natural flow in such a year was 2100 cu. ft. per sec. This is the third largest artificial reservoir in the world.

In addition to the main dam at Bitobi Rapids, two large cutoff dams were necessary, 3 small rock fills and 4 comparatively large earth dykes. A concrete cutoff was built over a comparatively narrow gulley on the West side of the river known as La Croix Creek, and on the East side at the head of the Castor Lake. The dykes are at the Divide of the Philomen Creek flowing into Lake Baskatong and Black Creek which entered into the Gatineau River some miles below the Bitobi dam. La Croix Creek dam contains some 25,000 cubic yards of concrete, the Bitobi dam which is some 1200 ft. long and a maximum height of 90 ft. contains some 67,000 cubic yards and Castor Lake dam some 30,000 cubic yards.

In the Mercier Dam at the Bitobi Rapids the control of the water is regulated by stony sluice gates and by submerged openings. The previous level on Baskatong was at 700 which through the control dam has been raised to 756. This level was obtained this year and even at that considerable waste water had to pass through the gates. Today, the reservoir stands at Elev. 752.77 which is equivalent to over 90 billion cubic feet. The main problem that had to be faced in the construction work was transportation. The sites themselves offer no great physical difficulty to economical development, but a 32

Fig. 4—Down-stream side of the Spillway Dam.

mile haul was necessary from the rail head over very difficult country roads. The first 20 miles were not too bad with normal traffic, but the last 12 miles of road had to be practically rebuilt. At first the building of a railroad to the site, was contemplated, but owing to the time this would take this scheme was abandoned. Tractors were then decided on, and the results obtained from these machines were very satisfactory, some 35,000 tons of material being hauled.

Progress of Work on the Gatineau-Toronto 220 kv. Transmission Line (First Circuit)

GOOD progress is being made with the erection of the steel structures to carry the conductors for the new 220,000 volt line from Chats Falls on the Ottawa River, to Toronto.

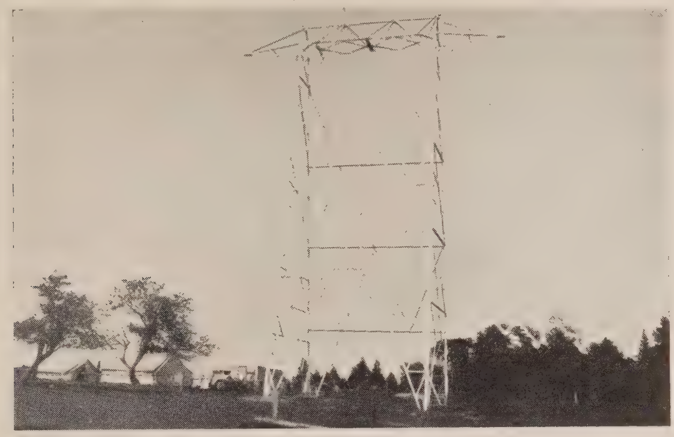
Construction work was commenced in the field during July. Only two footings were installed at the end of that month, and the erection of steel towers did not commence until August, but by November 15th, during 90 working days, one third of the footings were installed, ready for the support of the towers, and approximately one-quarter of the steel structures were erected during 70 working days, ready for the insulators and conductors.

Work to date has been done largely on the west end of the line, where earth excavation only has been encountered. During the months of September and October as many as 250 men were employed on construction, this figure not including the aerial and field surveys, which have been in progress for about a year, and the clearing of the right-of-way, which is being done largely by the owners of the property over which the transmission line crosses.

Up to November some 400 farm and land owners had been interviewed and agreements made with them for the location of the towers, and for the securing of the necessary right-of way.

The transmission and distribution of electricity has become so general throughout Ontario that most land owners in the Province now appreciate the necessity for the erection of these high power transmission lines before electric service can be given to themselves and others. Delays on account of acquiring right-of-way have therefore been reduced to a minimum. Conditions in this respect would appear to be different here from Great Britain, where the Electricity Commissioners, the regulatory and facilitative body appointed by the British Government, recently found it advisable to issue a Memorandum urging upon local authorities and land owners the necessity for their being reasonable in the granting of wayleaves (easements) for transmission lines in that country.

The Memorandum mentioned can be obtained from the Electricity Commissioners of Great Britain, at Savoy Court, London, W.C. 2, and it states, in part, that "the development



First Tower Erected

of electricity . . . necessitates the fullest possible use of overhead lines and adequate facilities for way-leaves" and that "it is not possible for a local authority to veto overhead line proposals or for a land owner to exact a wayleave rental in excess of what is determined by the Minister to be reasonable."

There is in Ontario very little need for any special regulations of this kind when a transmission line is being constructed across the property of Ontario farmers, as extreme and expensive delays and unreasonable charges are seldom encountered.

The contract for the supply and fabrication of the steel transmission towers for the above line was placed with the Canadian Bridge Company, of Walkerville, Ontario, in April 1927. Up to November 8th, over 3,000 tons of steel had been fabricated, and of this amount some 2800 tons, or approximately 50 per cent. of the estimated total requirements were galvanized and ready for shipment, or already in the field. It is hoped that with this amount of progress it will be possible to defer all work which is difficult and more expensive under winter conditions, such as digging earth, etc., until next spring. A certain amount of rock drilling, which occurs in the eastern portion of the line, will, however, be carried out during the winter, and since the

A Clearing for Right-of-Way, showing rubbish piled for burning.

stringing of conductor is sometimes facilitated when there is some snow on the ground, an attempt may also be made to erect some of the conductor during the winter, all being arranged so that power may be delivered to the Niagara System at Toronto during the fall of next year.

The accompanying photograph shows the type of steel structure which is being used on this line. The construction is somewhat similar to that which is being used for 220-kv. services in California and Pennsylvania, excepting that the clearances are greater. Another view shows the right-of-way cleared, in rough districts, with the brush piled, ready for burning whenever permits can be secured. Brush can be burned safely in wooded districts, only at certain limited times in each year.

Grounding Devices and Equipment

December 8th, 1927

To the Editor of The Bulletin:

In your issue of November 1927, on page 438 under the sub-heading of Artificial Grounds, Mr. S. W. Borden presents the suggestion that "the customer should be required to drive two rods or pipes, the rods being alike and driven to the same depth six feet apart . . . he should be required to stipulate on his application the measured resistance of the two rods in series. When he finishes up the job he connects the two rods in multiple and to the system and so far as he and the owner are concerned their part is done, and they have no further obligation with respect to the resistance of the artificial ground."

In my opinion such a method of test is open to criticism in fact it is difficult to see that the results obtained by testing the two rods in series can be any criterion whatever of the effective ground resistance when they are connected in parallel. An examination of the lines of current flow in the former case will show that such lines are lines of equal potential along which current *does not flow*, in the latter case. Considering two hypothetical cases it will be apparent that a false sense of security might develop from an unqualified use of such a method of test. First assume that for some reason, intentional or otherwise, the conductivity of the soil between rods be much better than that adjacent to but outside the area included by the between rod measurement. It is possible that they may be bonded below the surface and have a resistance in series of only a few ohms but their resistance in parallel may be many times that value. Second, suppose one rod be driven so that it comes in contact with some under ground conductor such as water pipe, etc., which would make a good ground. A second rod is driven in sand and the resistance of these in series is found to be quite high. (We have found grounds where rods were supposed to have been driven five feet deep to be as high as two thousand ohms resistance and

several over five hundred ohms). Connected in parallel a very good ground would be available though the second rod be practically useless.

We realise the necessity of providing low ground resistances and the desirability of some simple rule of thumb method of determining its value but a method of measurement such as suggested should not be allowed to gain credence without being subject to such criticism as it deserves.

Yours very truly,

(*Sgd.*) W. B. BUCHANAN,

Drying Lumber with Electric Heat

BY the use of electric heat for drying its lumber, the Chicago Lumber Company, of Oakland, California, has found it can dry its lumber in two days' time, without damaging the wood, and with low operating costs. This company has made two installations of electric lumber-drying equipment in its plant.

The drying box used has dimensions approximating 10 ft. wide by 7 ft. high and 21 ft. long. It is constructed of ship-lap, backed by moisture-proof paper, and insulated with packed shavings. The lumber to be dried is principally short lengths used, after drying, to make up window and door casings.

Moisture equivalent to 5 per cent. of the weight of the dry lumber is removed, it is stated, within 48 hours without end-checking or other damage to the lumber. It was estimated before installation that the drying would require 100 kw-hr. per 1,000 board feet of lumber, but actual operation has shown a much better economy. The cost of power is 1.15 cents per kw-hr., comparing favorably with the cost of oil at $1.25 per barrel of 42 gal.

Four General Electric form G oven heaters comprise the heating elements, with a total connected load of 15 kw. The temperature is controlled automatically at 90° fahr. at the beginning of the drying cycle and at 120° fahr., near the end of the period.

Air Circulation by Natural Draft.

Cold air is drawn in by natural draft through four openings in the floor of the drying compartment, and a heater is placed over each opening. The moisture-laden air escapes through an opening in the roof, so located that the air must pass over the lumber before it is ejected. A temperature controller, with a sensitive bulb 25 ft. long, is spread out over the ceiling of the compartment and thus controls the average temperature over the whole of the drying box.

Lumber is run into the drying compartment on trucks and is so loaded as to give ample space around each piece to allow free air circulation.

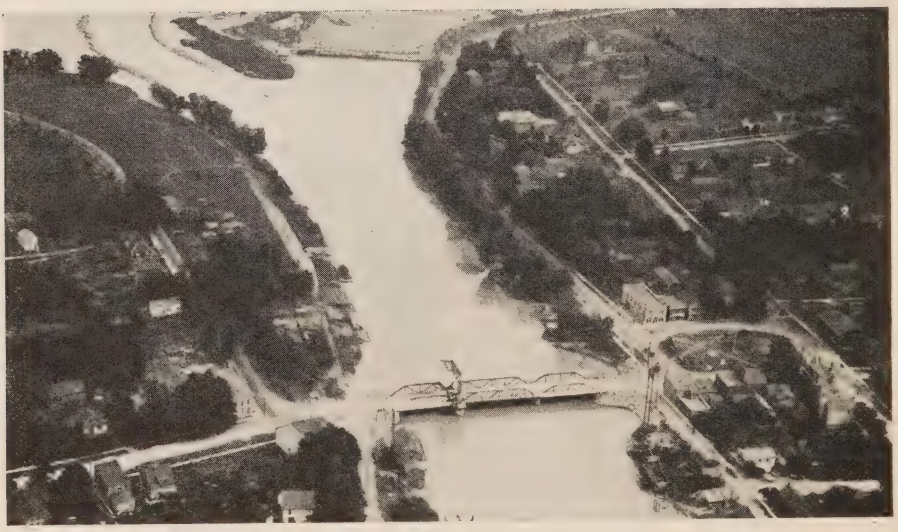
Electric heating units are also installed in the company's glue room where window and door sash parts are glued together. In this room

(20 ft. by 60 ft. by 12 ft.), it is necessary to keep the air heated so that the glue may be dried thoroughly by the time the sash has passed from one end of the gluing machine to the other.

The heating equipment consists of eight General Electric form G heating units mounted in a Sturtevant specially-constructed blower equipped with a 20 in. motor-driven fan. The fan, motor, and heating units, taking up a space of but 30 in. by 34½ in. by 27 in., are installed near the ceiling at one end of the room.

In operation the fan draws cold air over the heater and the heated air is blown directly toward the opposite end of the room, thus bringing the air in direct contact with the sash passing through the gluing machine. The temperature is maintained at 85° fahr.

—*The Heating and Ventilating Magazine.*



Application of Hydro-Electric Power to Farm Work

Article No. 11

Chopping Demonstrations

BECAUSE of the interest shown in the use of Hydro Electric power for feed chopping by a number of farmers in the Milton District arrangements were made by Mr. R. W. Philip, Superintendent at Milton, and the Wagner Electric Manufacturing Company, to demonstrate the use of the electric motor for such application. It was felt that such a demonstration would give those interested an opportunity to inspect a motor-driven chopper in actual service, and would serve to convince them as to the amount of grain which could be handled and the satisfactory nature of the product obtained.

The installation was made at the farm of Mr. A. E. Woodley, about two miles from the Town of Milton, on October 6th, 1927, and some twenty-five or thirty farmers from the vicinity were in attendance during the afternoon or evening. This is a 100-acre farm on which are kept 20 head of cattle and 3 horses. The average consumption of chopped feed is in excess of 50 bushels per week.

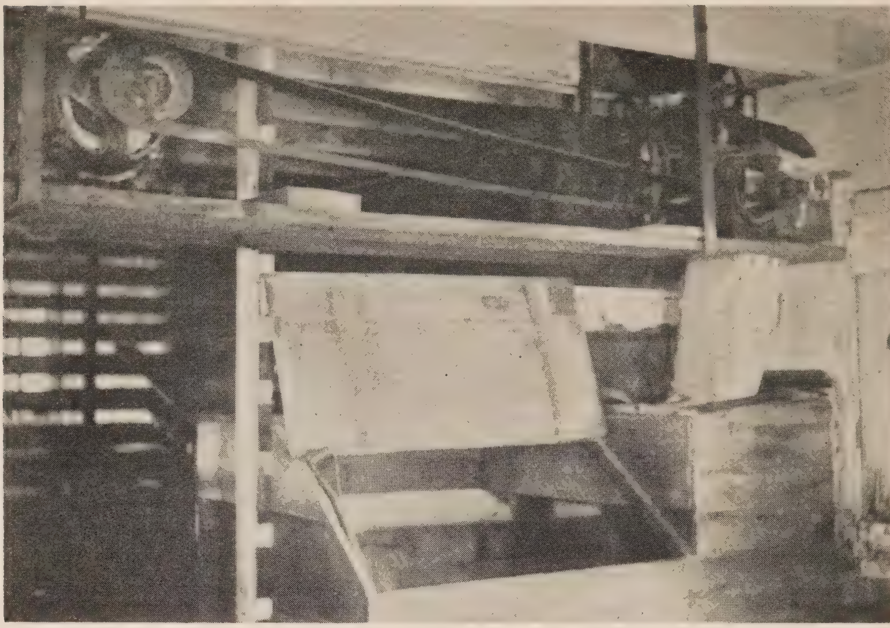
The chopper used was a 6½ in. plate machine of the rigid head type and ball bearing construction manufactured by Moore Bros., Toronto, this being belt driven by a 3 h.p., 110-220 volt, 1425 rev. per min. repulsion induction type, Wagner, single-phase motor. Both motor and chopper were bolted to the floor, the pulley centres being spaced about 8 ft.

Tests were made with pulleys on the motor, giving a chopper speed of about 3100 rev. per min., and 2500 rev. per min. Operation at the lower speed appeared more satisfactory as at the high speed there was considerable belt slippage, so that the chopper speed and feed was not uniform.

A bag of dry, hard barley, weighing 96 lbs., was put in the hopper and ground very fine so as to be suitable for pig feed. At the higher chopper speed this was ground fine in 15 minutes, while at the lower speed a 96 lb. bag was ground in about 11 minutes. The quality of the chop appeared very satisfactory to those present, and quite equal to similar grain chopped at the local mill.

A bag of mixed barley and oats, weighing 70 lbs., was ground to size suitable for cattle feed, the time required being about 8 minutes at the higher speed, and 5 minutes at the lower speed. In a test made on Dec. 10th, Mr. Woodley ran 22 bushels per hour, and on a previous occasion 388 lbs. of 2-year-old barley was ground very fine in one hour.

On this farm there are in use an electric range, washing machine,



An excellent chopper installation, with a 3 h.p. motor driving a 6½ in. rigid head ball bearing grinder. A bin on the floor above of about 30 bu. capacity supplies the hopper, the chop being delivered to the feed box below.

vacuum cleaner, toaster and iron, while an automatic water system is being installed. The actual cost of power for operation of the chopper motor is less than 1c. per bag, the energy consumption being about 9 kw-hr. to chop 20 bags.

Thus it is evident that a chopper of this type will handle more than 100 lbs., of fine chop, or 150 lbs., of coarse chop per h.p. per hour, and that the 3 h.p. motor is capable of grinding a minimum of 300 lbs. of fine, or 500 lbs. of coarse chop per hour.

The total time of running while demonstrating was between 3 and 3½ hours, the current consumed (metered) 9 kw-hr. and the output 20 cwt., less than half a kw-hr. per cwt. About one-quarter, or less, of this was fine chop, the balance coarse. As the other uses on this farm result in getting into the "follow-up" or 2c. rate in each billing period, it is fair to consider the cost of doing this work at that rate, and, therefore, the current cost was 16c. net for chopping the 20 bags or ¾c. per bag. Apparently from notes taken of current consumed when chopping fine the cost would be about 1½c. per cwt.

In installations of choppers and motors the maximum output of chop is obtained by belting direct to the chopper and service to other power using machinery should be supplied through a line shafting. A separate belt should be ready and the one required used. At a slightly increased

cost a motor can be secured with a pulley on each end if desired.

The class of service supplied to the Woodley farm is No. 3. The rate —Service Charge $4.55 per month; Consumption Rates, 6c. per kw-hr., for the first 42 kw-hr., in each month and 2c. per kw-hr. for the balance, with a prompt payment discount of 10 per cent.

The installation is:

Lighting — —	1400	watts
Electric range — —	7700	"
Electric iron — —	600	"
Vacuum cleaner —	80	"
Washing machine —	186	"
½H.P. motor for pumping	375	"
5 H.P. motor for barn power uses — —	3750	"
Total	14091	"

The power consumption and net bill are submitted in the tabulation below.

Service was connected on December 23rd, 1926.

It is to be noted that the uses of power for chopping increases the net bill very little. This does not appear in the record submitted, but is the result of interim meter readings which do not appear in this record.

Outdoor metering installation on transformer pole of a farm service.

Recently a similar demonstration was held on the farm of Mr. Geo.

Period ending	Months	Kw-hrs. Total	Kw-hrs. at 2nd rate	Net Bill
April 30	4 1/4	186	8	27.08
July 31	3	186	60	20.17
Oct. 31	3	579	453	27.24
	10 1/4	951	521	74.49

NOTE—Range installed late in June. Chopper installed October 6th.

Oliver at Kintore, with about the same results so that it is reasonable to assume that similar economy could be obtained on any farm where chopped feed is required.

The above record gives details of only one of many demonstrations that are being made not only by the Commission, but by sales organizations of different kinds, and the Commission believes such demonstrations should be made by dealers or any Company or organizations interested in the sale of appliances or equipment for use on the farms. It is essential in making such demonstrations to have a metering equipment installed at the time so that information may be given as to the actual power used and the cost of such service, fitting it into the actual conditions of service as given on the place at which the demonstration is being made.

Infestation of Tomatoes Prevented by Lights

By E. C. Easter, Agricultural Engineer, Alabama Power Company, Birmingham, Ala.

IN 1926 much damage was done to tomato patches in Alabama by fruit worms, the adult stage of which is a moth. As a result it was decided this year to install electric lights in a tomato patch to see if these moths could be trapped, thus preventing them from laying eggs. Although the results obtained to date are not conclusive, they indicate that a great deal of good is accomplished. This work is being done by Professor J. M. Robinson, head of the entomology department of the Alabama Polytechnic Institute, in conjunction with the Alabama Power Company, and the farm of S. P. Storrs, in Elmore County, is being used for the experiments.

The installation consists of eight lights spread over a two-acre patch. The lights are adjustable, but the best results appear to be obtained when they are about 5 ft., above the ground. A 20-in. flat reflector is used, under which is hung a pan of water covered with kerosene. Of the eight lights, six are 100 watts, one is 200 watts, and the other is 40 watts. These are clear, though experiments have been made with inside frosted lights.

From the two-acre patch, approximately 40,000 lbs., of tomatoes were sold. This represents about 136,000 tomatoes. A very energetic effort was made to determine how many tomatoes in this patch were damaged by fruit worms, and only 35 worm infested tomatoes were found on the two acres during the entire season. Mr. Storrs' neighbors who produced tomatoes without the use of lights had an infestation of from 30 per cent. to 50 per cent.

Three lights are also being tried out in a cantaloup patch of one acre. In this patch efforts are made to catch the pickle beetle, one of the most serious enemies of melon producers.

The tomato patch is supplied with water from an overhead irrigation system, which was in use last year as well as this. By using this irrigation system the tomatoes are ready for market several weeks before tomatoes not so watered. Also approximately five times as many can be raised in this way as can under normal field conditions. Assuming that Mr. Storrs would have suffered the same damage without light, that was experienced by his neighbors, the lights resulted in a saving of at least 12,000 lb. of tomatoes. At ten cents per pound, for tomatoes (the minimumpricereceived by Mr. Storrs, the above saving amounted to $1,200.

—*Electrical World.*

A Citizen Engineer

By William L. Widdemer, General Electric Company

NOT every citizen can be a good engineer, but every engineer can be a good citizen. Whether within the walls of a research laboratory or in the physical freedom of field work, the electrical engineer is conscious that his should be a public service. Hence, whatever his choice, considerations of temperament should enter into his selection of a specialty as much as does its inherent appeal; and the wise man will give heed to his own personal equation. Only thus can he be sure that his non-technical qualifications will promote his professional progress and, at the same time, enhance the value of his citizenship.

If a man does his best work aloof and undisturbed, there are fields of scientific investigation that offer him unlimited opportunity. If, on the other hand, he feels a special thrill in the more intimate applications of electricity to men's needs—if he has an excellent capacity for human fellowship and a real penchant for public affairs—he may safely intrust his technical vocation to this directive impulse and become a Citizen Engineer.

Modern City, the Child of Electricity

It may be said almost literally that the modern city is the child of electricity. Its very life depends on electric transportation (vertical as well as horizontal), electric communication, and, to a large extent, electric industrial applications. But in addition to stabilizing these accepted factors of civil life, the industry has undertaken another service, fluid and vital, which marches with the feet of men and crowns their cities with distinction. It began when the first arc lamps were erected at a few street corners and has developed until now it enters essentially into every advanced counsel that citizens take for protection and for civic extension and beauty.

Municipal expansion and the orderly conduct of the common life on the street are, more and more, being rescued from the misrule of Haphazard, and intrusted to the wise administrations of the City Planner. Civic authorities are frankly seeking specialized aid in matters of zoning, public lighting, decorative illumination, and traffic control. They are studying how best to divide commercial and residential areas and to assure a well-balanced development of both. They are beginning to appreciate the constructive values of electricity in the solution of all these civic problems; and with this realization, they are ready to make an honourable place for the man who unites technical knowledge of electrical applications with sympathetic human insight—the Citizen Engineer.

Electric lighting has become a veritable instrument of precision when applied with scientific method to municipal problems. Nicely adjusted, in accord with technical principles, it builds business districts and promotes trade; it attracts home-builders to desirable residential districts; it discourages crimes of violence and makes the paths of traffic clear and safe; it reaches out into the countryside and encourages suburban development.

The street-lighting specialist is a liaison between the science of electricity and the science of government—interpreting each to the other—translating economics into watts, the energy of a generation into generated energy, the current of traffic into a current of electricity. He takes the x of municipal development, incorporates it in a mathematical formula, and finds its value in terms of humanity.

The floodlighting of buildings and monuments has established a technique of its own in the service of architects and in the cultivation of a public appreciation of their art. It is particularly adapted to the new American architecture but its application demands not only a thorough technical understanding of light projection and distribution but also a nice appreciation of artistic values and of the architect's intent. In the serene radiance of a floodlighted structure during the hours when men have leisure to study and admire, the engineer performs a service to both the architect and the community.

The Motorist's Interest

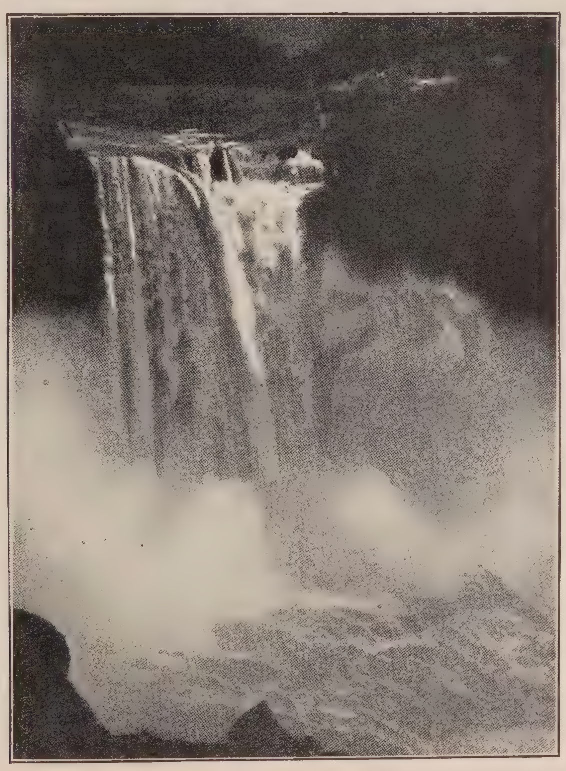
With the increasing acceptance of traffic control through electric signals, every motorist (and every pedestrian) has an intimate interest in the skill with which the equipment is designed, installed, and operated. The engineer who is prompted to make this field his specialty finds himself plunged into the very heart of civic life; he deals with men as much as with apparatus—with human contacts as well as with electrical. On the one hand, the city administration depends on him for authoritative advice; on the other, the citizens depend on him for safety.

Light and power companies are constantly and justly seeking to strengthen their bonds of friendship with the people whom they serve. Modern central-station practice has made the street-lighting and traffic-

signal loads increasingly desirable. A peculiarly personal contact with the public and with public officials is afforded to specialists in these departments who, accustomed to think scientifically and to feel after the manner of men, are in a position to render important service to those who sell as well as to those who buy electric energy.

It was estimated that in the year 1925, seventy per cent of central station revenue derived from electricity was returned by lighting sales —and yet this represented only 27.5 per cent. of the energy output. Here is a profitable market that can be approached on the highest plane of ethical salesmanship—a real public need which the public has only begun to appreciate—an enterprise calling for precise knowledge of central station technique and an honest enthusiasm for public service.

The electrical industry needs more ways to popular appreciation; the public needs riper knowledge of electrical service. Both need the Citizen Engineer.—*The N. E. L. A. Bulletin.*



Electrical Preparation of Cereal Foods

By E. V. Buchanan, General Manager, Public Utilities Commission, London, Ont.

"HYGIENIC Foods" might very well be the slogan for the cooked cereal foods that are prepared by the Kellogg Co., of Canada, Ltd., in their efficient and hygienic plant in London, Ont. Here is a plant producing foods of world fame that utilizes hydro power to the uttermost, not only for efficiency and the accompanying minimum cost of operation, but in order that the raw product can pass through the mill and the various stages of the cooking process and can finally be shipped in a sealed packet, without being touched by hand.

Electricity for Hygiene.

This merit of hygienic handling is fast becoming appreciated and electrical appliances are being installed in greater numbers in plants where foods, liquids, and drugs for human consumption are prepared.

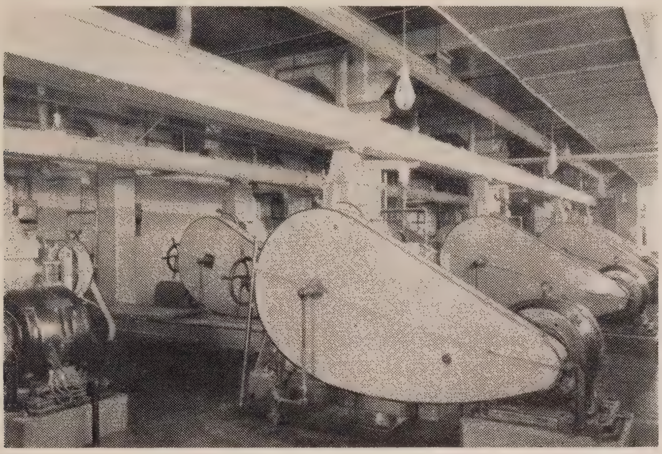
Not long ago, food plants throughout the country were adopting the electric drive for economic reasons, but now the Canadian factory managers are sold on that score of economy, they are adding to their plants numerous electric applicances, such as electric bake ovens, and electric conveyors, in order that the foods should be prepared under ideal sanitary conditions, knowing that electrical energy is far cheaper, as well as being more controllable, than any other form of energy.

The raw products entering the Canadian Kellogg plant are corn and wheat and the prepared foods are the well known "Corn Flakes," "Pep," and "Krumbles." These are distributed throughout Canada and the British Empire.

Freight Cars Handled Electrically.

From the moment the freight cars are left in the siding, electric power begins its work. A 25 h.p. car puller, that is located similarly to a hoist outside the shipping door, handles the cars so that each car can be brought exactly opposite the mill door. The bags of wheat and corn are then unloaded on to a 25 h.p. conveyor which elevates them to the automatic scales, where definite quantities are weighed. There is a 75 h.p. motor for general power that drives a corn separator and several conveyor belts. This separator contains a permanent magnet which extracts any large pieces of stray metal that have inadvertently been left in the cereal. The remainder of the motors are practically all individual drive throughout the mill.

For cleaning wheat and taking out stones, etc., a disc separator is driven by a 25 h.p. motor. Then there are two individually driven degenerators that extract the germ from the wheat and corn. These machines are driven by a 40



Corn Flake Rollers, chain driven by 40 h.p. motors.

h.p. and a 42 h.p. motor, respectively.

All these operations of extracting the coarser material that is not fit for human consumption leave a by-product which is carefully collected and ultimately ground up for cattle feed. The machine grinding this feed is operated by two 15 h.p. motors, driving two grinders in opposite directions.

Unique Service Elevator.

The most striking thing to the visitor of this mill is the service elevator which serves the dual purpose of carrying passengers and bags of wheat, corn, or feed to any one of four floors. It consists of an endless band of fibre almost two feet wide, that runs vertically up through a hole in each floor. At distances of about five feet are alternately iron handles and folding platforms. These platforms likewise alternately fold in different directions so that each alternate one is a step, onto which a sack of flour can be placed or upon which a mill-hand can travel. These platforms, which are folded on their upward journey, open out to receive their load on their downward journey. By this method, considerable staircase space is saved in the mill, and many foot-pounds of energy conserved by the operators. The motor driving this unique service elevator is a 3 h.p. squirrel cage induction motor and it is in constant operation during working hours.

The visitor is also impressed by the lack of dust in this modern mill. This condition is due to each machine being connected by pipes to one or two dust fans. These fans, each individually driven by a 10 h.p. motor, draw off any flour which is also ground up with the cattle feed.

The wheat is conveyed away to the cook-room by a 2 h.p. motor, to storage bins.

Lengthy Electrical Cooking Process.

A description of the cooking process that the corn now is subjected to will give the reader a fair idea of the value

of electricity in handling the grits (corn when it leaves the mill) until they are ready for the breakfast table.

The grits are fed from the bins into six rotary steam cookers, which give the corn a preliminary hardness. These cookers have temperature relays and are each individually driven by 2 h.p. motors which have start and stop push buttons. The main switches for these machines are located below in the oven room together with the magnetic control relays. To extract any moisture from the corn, and bran from the cookers, a 15 h.p. fan is used. Likewise, a 7½ h.p. agitator extracts any foreign material. Next, the corn passes through a "loosener" driven by a 1 h.p. motor and down to the reel room. Here, four units each 5 h.p., break the corn up before going to the drying racks. These drying racks extend down to the basement, through virtually five drying rooms. There are four units, each having a 15 h.p. fan that blows hot air up from below. The last drying room is at a temperature of 200 deg. Fahr. A 5 h.p. elevator

Toasting Ovens. Each oven has 110 kw. elements, under thermostatic control and 2 h.p. motor for conveying flakes through. General conveyor belt driven by 3 h.p. motor, carrying away toasted flakes is under cover in front of ovens. A 10 h.p. fan ventilates ovens.

carries the corn back up again to storage over an electro-magnet that catches any stray metal. For these electro magnets, as there are a number in the plant, there is an 8.5 kw. motor-generator set supplying 125 volts d.c.

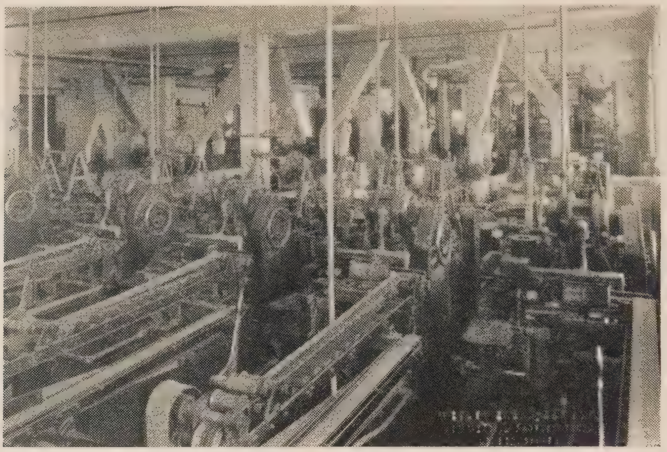
The corn, after passing through tempering tanks, is now in a condition to be flaked. The flaking machines consist of heavy chilled steel rollers, revolving in opposite directions at different speeds. The small piece of corn is rolled into a thin flake many hundred times its size, the flake being peeled off the rollers by knives. There are eight units, each with ball-bearing rollers and chain driven by 40 h.p. motors. Also, there is a 42 h.p. unit.

Large Electric Toasting Ovens.

These thin flakes are then fed into the toasting ovens, of which there are eight, operating between 400 and 500 deg. Fahr. Each oven has two elements of 110 k.w. that are each under thermostatic control from a nearby switchboard. This switchboard has eight panels, one for each oven, each panel having mounted thereon two three-pole relays, enabling each oven to keep a definite temperature. An oil circuit-breaker at the end of the switchboard carries the oven load. The auxiliary equipment for each oven consists of a 2 h.p. motor with chain drive to carry the flakes through the oven, a recording thermometer and a 75 watt daylight lamp. The latter is very necessary because the corn flakes are judged by their color and the management say that better results are obtained by artificial light than daylight. Any fumes or smoke are drawn off the ovens by a 10 h.p. fan and in addition the room is ventilated by a 1 h.p. fan. The cooked flakes are caught on a travelling belt that is driven by a 3 h.p. motor, the belt being kept scrupulously clean and free from oil by the use of ball-bearings instead of the usual sleeve bearing.

The corn flakes of golden color pass an inspector as they travel by on the conveyor belt. He takes periodic samples which are weighed and inspected for color and flavor. The flakes then pass to a 5 h.p. conveyor belt, which elevates them to movable bins. Here they cool and are then dropped through chutes to the packing room.

Similarly to many other plants that wish to be self-contained, the Kellogg company maintain their own printing shop in the basement. Here the boxes and packets are printed and stacked away for future consumption. Slip-ring induction motors are used in this department (all previous motors being squirrel cage) of the following ratings: cardboard machine 25 h.p. and 20 h.p.; sticker and creaser for cases, two 5 h.p. motors; printing press, 15 h.p. These boxes and packets are taken to the packing room as required; the flat package being fed into the beginning of the packing line and the boxes meeting the filled packets at the end of the line. The first operation of packing consists of making the packet from the flat printed piece of cardboard. A 2 h.p. motor drives a fan which neatly blows the box over in its travel and also drives a chain conveyor that folds the packet into



Packing Room where packages are formed, filled and sealed by electrically driven machines

shape and sticks the bottom. Next, two 1 h.p. motors provide the motive power for making the waxed paper sacks that fit into the packets and a 500 watt heating element heats the waxed paper which is stuck by pressure.

The packet is now ready to receive the corn flakes, which are automatically weighed after being fed into the packet. Following in sequence, another 2 h.p. motor continues the procession and a 120 watt heating element seals the waxed paper sack and finally the top of the packet. All the heating elements have pilot lamps in series, indicating continuity of operation.

Now that the corn flakes are safely sealed the human hand is allowed to pack these packets in the boxes, each box holding 36 packets. Each box is checked and tabulated on an electric adding machine and finally conveyed away on a 1 h.p. conveyor to the shipping room.

The contract with the local Public Utilities Commission is so arranged that the ovens are cut off during both the local peak periods and the Hydro Commission's peak periods. These periods are between 11 and 12 every day except Saturdays, Sundays and holidays, and for varying periods in the evening during the winter months. With the exception of these peak load periods the plant operates 24 hours a day, and has therefore a very high average load-factor. The load being a non-inductive one the power-factor is also very high, and is well over 90 per cent.

Getting the Industrial Executive Interested in Safety and Keeping Him that Way.

By Frank W. Smith, Vice-President and General Manager, United Electric Light and Power Company, New York City, and Past President N.E.L.A.

(An address before the Opening Session of the Public Utilities Section of the National Safety Council's Sixteenth Annual Safety Congress, Chicago, September 27, 1927.)

THE assigned topic would seem to carry the implication that some executives need to be sold on the safety idea; that they are not now sufficiently interested in the movement which has brought together here today three or four thousand men who are devoting a large part of their time—some of you 100 per cent. of your time—to the profession of accident prevention.

There is no doubt of the interest in safety, the *humanitarian interest* in the protection of life and limb, held by all of us and by the greater number of industrial executives who have not been able to attend this Sixteenth Annual Safety Conference. The real question is: "Mr. Executive, what are you *doing* about it?" Are you merely authorizing safety work and approving vouchers for the expense involved or are you personally getting right down on the firing line with your safety engineers, your superintendents and managers, and helping them, with your own personal efforts as well as your signature and your sympathetic interest, to carry on the fight.

Practical Interest in Safety

An example of this practical type of interest in the safety movement was shown at the last Safety Rally of the Metropolitan Section of the National Electric Light Association held in New York City. This Section or Division of the Association is made up of several thousand employees of the local electrical utility companies in Greater New York. At this meeting there were present chief executive officers of nearly every one of the utilities in the district—presidents, vice-presidents and general managers. Many of them spoke, others encouraged the safety committee and employees by their presence and co-operation. There were more than 3,000 employees present at this rally, and for "safety" the police were obliged to close the doors before the meeting could be gotten under way. This explanation is made because the speaker does not wish, in the remarks that follow, to be understood as implying that on the whole the executives of the utilities are not actively interested in safety.

Since the earliest days of the safety movement it has been axiomatic that to succeed in any permanent campaign for the prevention of accidents it is first necessary to sell the safety idea to "the big boss", or, as we are more likely to say today, to the chief operating official. It was recognized

at the start and it is just as true today that the safety spirit must saturate an industrial concern or a public utility from the top down; that the rank and file of employees, foremen, superintendents and even higher plant officials would not do their best to prevent accidents unless they were sure that the top man was thoroughly sold on the idea.

And so from the earliest days of the movement professional safety men and others interested in the subject have made speeches and written papers on how to create and maintain the executive's interest in accident prevention. Undoubtedly hundreds of addresses have been made on the subject, many of them inspiring addresses, but largely they have sung the same song : "Show him it PAYS to prevent accidents"; "Convince him it is cheaper to PREVENT accidents than to PAY for them"; "Prove the economic soundness of accident prevention"; scores of titles, but all using the same technique.

Now, with your permission, the speaker will depart from this technique, for it is his belief that the dollars and cents value of the safety movement have been very much overdone. Granted that money invested in accident prevention will—when the work is carried on in a thoroughly organized and efficient manner—yield a fair return on the investment; then let us go further and accept the statement, often made, that certain companies have secured a higher percentage of return on the money invested in safety work than on the investment in manufacturing equipment. Still, I venture the opinion that it is a mistake to concentrate on the economic value of accident prevention in trying to interest executives.

After All, He's a Human Being

Let us examine for a moment this unusual species of man known as "the executive" or "the big boss", sometimes endowed also with such adjectives as "hard-boiled", "cold-blooded", "hard-to-sell", or just plain "stubborn", who, some seem to think, must have his interest in the saving of human life and limb created in some special mysterious manner. As a matter of fact, your executive usually has a wife and children; he probably plays golf, or he is interested in some other attractive and health-giving, outdoor sport. He has, or he ought to have, a sense of humor, and enjoys a good story; sheds a tear in the theatre now and then, and eventually goes the way of all flesh. In other words, the executive is usually an ordinary human being with the same warm blood, the same emotions, the same love of life and the same aversion to suffering and premature death—both for himself or the other fellow—that all human beings have.

Yet we too often try to interest such a man in the saving of human life wholly on the strength of the dollars and cents value of safety.

I have in mind an incident which illustrates the point I am trying to make—that the legend of the big industrial executive as essentially a cold-blooded business man is fictitious. Several years ago there was undertaken in New York a campaign to

demonstrate through one week's intensive effort, that radical reductions in accidents—both public and industrial—were possible even in the rush and bustle of the biggest city in the world. The leaders of this movement felt that its success depended on their ability to secure the sponsorship of an outstanding man whose identification with the campaign would bring the interest and support of the entire community of seven million people. And so Judge Gary, chief executive of the United States Steel Corporation and one of the founders of the safety movement, was asked to head the campaign, which he consented to do.

JUDGE GARY'S WORK FOR SAFETY

Judge Gary, in whose death, a few weeks ago, the nation and the whole world lost one of its outstanding men, was at that time 75 years old, and was personally directing the biggest business enterprise the world has ever seen. Because of these two facts and the further fact that for many years Judge Gary has confined his public addresses to the annual meetings of the Iron and Steel Institute, the delegation (headed by Arthur Williams, vice-president, Commercial Relations of the New York Edison Company and president of the American Museum of Safety) which persuaded Judge Gary to accept the chairmanship of the Safety Week Campaign, did so with the understanding that he would not be expected to make more than one speech during the week, that on the opening day of the campaign.

Well, to cut the story short, the Judge so warmed up to his subject in that first speech, he was so impressed with needless waste of human life through accidents still going on twenty years after the start of the safety movement, that he made, not one speech during the week, but more than a dozen. He spoke twice a day in widely separated parts of Greater New York, and, if I am correctly informed, made three addresses on one day. Incidentally the dollars and cents value of safety was not even mentioned in the conference at which Judge Gary was induced to take a week from the time of a billion dollar corporation and from his private life, at the age of 75, to help put public safety on the map.

We have heard it repeatedly stated that the Steel Corporation has *spent* millions of dollars for safety and has made millions of dollars upon this investment. The late Judge Gary has repeatedly made public utterances concerning the corporation's interest in safety as a good business proposition, wholly aside from its humanitarian aspects, but the most significant statement concerning both the economic and humanitarian value of this great work that I have ever seen comes also from the pen of Judge Gary; in fact, from his last published statement. I quote from the current issue of *Coal Age* in which Judge Gary said:

"During the last fifteen years we have spent upward of $170,000,000 for safety, sanitation and employee welfare activities. These expenditures have been fuly justified. They have been more than recovered in dollars and cents. But of far more importance than the recovery of the expen-

ditures, the happiness and gratification resulting to our many thousands of employees and their families, as well as to the management, through good health and safety of life and limb, have been beyond computation, beyond any measure in dollars and cents."

It is time we stopped thinking of chief executives, chief engineers and other high supervisory officials primarily as cold-blooded men who are influenced in their business decisions only by logic, statistics or financial considerations. Of course, it would be just as bad to go to the other extreme and assume that they are sentimentalists, and can, through mere "sob stuff", be made as vitally interested in safety as in the business or profession to which they have devoted their lives. But is there not a middle ground ?

The Personal Responsibility

There can be no doubt that most executives appreciate their personal responsibility for the welfare of the men and women making up their organizations. I believe it means much more to an executive to hear that John Smith has lost an arm or an eye than it does to hear that the company has lost a sum of money through such injury. And I am sure it means much more to any general manager to be told that "we didn't kill or seriously injure a single employee" than to hear that so many thousands of dollars have been saved in compensation costs or insurance premiums.

There is another, and important, reason for using something other than the dollars and cents technique in trying to interest executives not already so interested in safety *(if there be any such)*. I refer to the fact that it is impossible to measure the value of human life in terms of dollars. Suppose, for instance, a certain young employee of the General Electric Company, who was later to be known the world over as "that wizard Steinmetz", had been killed in a shop accident. Could any of you tell the General Electric Company or the electrical industry as a whole what the accident cost the company and the country ? Or, if you think you are good at figures, estimate the dollars and cents cost of an accident that would have taken Thomas Edison from us forty years ago, or even now.

It may be true that there are not many potential Edisons or Steinmetzs among the men who are killed or permanently incapacitated through industrial accidents—and yet, who knows—but it is, nevertheless, impossible to measure accurately the real cost of such accidents, even when the victim is the most unpromising common laborer. First of all, to his own mother, wife, children, and brothers or sisters he is as dear as the man in the most exalted position. But wholly aside from that and aside from the cost of accidents in terms of compensation, which is too frequently referred to as the total cost, there are incidental costs which it has been difficult to measure accurately and which probably greatly exceed all the figures that have thus far been used to estimate the loss to the industry, to the workmen themselves

and to the nation, resulting from preventable accidents.

What Price Accidents

Here is a list of the incidental costs of accidents recently compiled by one of the leading insurance companies in the country:

1. Lost time of injured person.
2. Lost time of other employees.
   (a) Out of curiosity.
   (b) Out of sympathy.
   (c) Assisting injured.
   (d) Through shattered nerves.
3. Time lost by foreman.
   (a) Assisting injured employees.
   (b) Investigating cause of accident.
   (c) Arranging for injured person's work to be done by others.
   (d) Selecting, training, breaking-in new employees.
   (e) Giving information for state reports or attending hearings before the Industrial Commission.
4. Time spent on case by first aid and hospital staff.
5. Injury to machinery or spoilage of material.
6. Interference with production.
7. Cost of continuing wages in full when injured employee returns to work after recovery, even though his work may be only 50 to 75 per cent. of normal value.
8. Loss of profit on injured employee's productivity.

The person who prepared this list adds as a ninth item the question : "What would you count the cost if you lost one or two of YOUR fingers ?"

It should—of course, be borne in mind that this is only a partial list of the incidental costs; that it does not include compensation costs, or the cost of medical staffs and hospitals. There seems no doubt that if it were possible to gauge accurately these incidental costs it would be found that they are greater than the compensation costs of accidents which are now often erroneously referred to as the total cost.

The remarks thus far made here would seem to be devoted in large measure to "How *not* to sell the safety idea to executives and operating officials", and perhaps an apology is due those in attendance at this meeting, in view of the title of my subject, for having stressed this point. The speaker believes, however, that when it is recognized that executives are interested in, and influenced by, considerations other than financial, the most desirable method of getting executives interested in safety, and keeping them interested, will be developed by a study of the particular man and the situation within the particular property. There is no *one best way* of selling the safety idea to executives, because executives, no more than other human beings, thank heaven, are not yet standardized.

There seems to be, however, certain considerations which should appeal to operating officials and other executives of public utility companies. The person interested in converting an executive in this industry into a firmer belief in the value of thoroughgoing safety work might do well to take these special considerations into account.

The Safety of Workmen

First among these is the sense of obligation for the safety and welfare of the public which utility men have probably to a greater degree than executives of other industries, because life and health are directly dependent upon their services. The continuity of service—whether it be gas, electricity, water, telephone or transportation—is the first consideration of every official and every conscientious employee of a public utility, simply because it is recognized that a break in the service may result in death or injury, as well as inconvenience to some in the community. It is not necessary to dwell on this because it is in the blood of all you public utility men, and just as it is true that "a public utility is a business affected with a public interest", it is equally true that the strongest argument in favor of the utmost safety precautions in a utility is the PUBLIC INTEREST IN THE SAFETY OF THE UTILITY WORKMEN. The community is not protected against a break in the service or against accidents to the public unless the employees of the utility are working under the safest conditions, and with the spirit that is engendered in the employees only if the company is saturated with this spirit of safety from the top down.

Let me give you an example of this sense of obligation to the public. In the company which the speaker has the honor to represent, and, in fact, in the entire group of companies affiliated under the parentage of the Consolidated Gas Company of New York, every employee, both male and female, from the office boys to the presidents of the companies, some 33,000 in number, has been instructed in and examined for proficiency in the prone pressure method of resuscitation. This work is being intensively carried on, not because the office workers or salesforce or the executives are in any particular danger of electric shock or gas asphyxiation, but because it is believed that by having every employee in our companies instructed in this method of resuscitation, we are reducing throughout the community the chances of accidents and death to the public at large. We have a large number of cases annually where lives are saved to the general public in accidents entirely apart from the operations of our own business.

The second special consideration upon which we might seek the interest of the utility man (not already sincerely interested in safety)—and again, I say, if there be any such—is the fact that our industries are *not inherently* hazardous. This is another way of saying that most accidents in our field are preventable. There was a time, not so long ago, when the steel industry was listed as extrahazardous by insurance companies and others because it was thought that many of the fatalities in this industry were unavoidable, that they were legitimate risks of the trade, inherent to the industry, but now men have revised their opinions, and the steel industry is no longer classed as an extra-hazardous industry.

As a matter of fact, there are now comparatively few really inherent or unavoidable hazards, and it is the

writer's belief that those executives in our field who are not now as interested in safety work as they should be, are labouring under the impression that "accidents are going to happen anyway, and you cannot prevent them." Concentrate on convincing such men that IT CAN BE DONE rather than on how much money they will save if it is done.

They Can Be Prevented

Finally, having impressed the executive with the fact that his interest in the safety of the community and his interest in good public relations should pre-suppose the most thoroughgoing safety work on his properties; having impressed on him —with the substantial evidence available—the fact that ACCIDENTS IN THIS INDUSTRY CAN BE LARGELY PREVENTED, go back to my original premise that the executive is also a human being, and show him his opportunity, not to save money, but to save men, fathers, brothers and sons.

In a recent editorial in the *New York Telegram*, commenting on the report of the New York State Department of Labour, and following the statement that "measured in accidents to workers, the high cost of industry appears to be climbing", the editorial continues :

"One trouble with reports like this is that we learn of these injuries and deaths in figures, and figures are cold and dryly statistical. If we could go into the hospitals and homes and see broken heads, stubs of arms and legs, sightless eyes, saddened wives widows and orphans, and the hopelessness of humanity in stricken homes, we could understand better what the figures mean. Try to connect the figures with American homes when you read the statement of facts and figures in the report . . . .

"Those of us who have two arms, two legs, two eyes and a full complement of fingers and thumbs might well pause a moment to think something of this part of the high cost of comfort."

The Human Standpoint

This comment on the part of the public press brings out the point I am trying to make, and throughout these scattered remarks the human rather than the economic side of safety has been stressed. From the economic side the accomplishment has been great, but there is evidence to show that there is still much to be done, and it is not impracticable to estimate that this further decrease in the economic loss could be made a million and a half dollars ($1,500,000) annually in both public and industrial accidents, a figure which would represent not only a tremendous economic gain, but, what is far more important, saving in happiness and lessening of hardship in American homes and families. It is this last humane saving that should be the inspiration of all who are interested and to all actively engaged in this safety movement, which, after all, is one of both brain and heart.—*The N. E. L. A. Bulletin*.

Hydro News Items

Central Ontario System

The Canadian Flourspar Co., has applied for power to operate their mine near Madoc.

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The Canadian Industrial Alcohol Co., expects to greatly increase its load in the near future. This Company, which is located some distance outside Belleville has made considerable extensions to its plant necessitating the installation of an extra 750 kv-a. transformer in the Belleville station.

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The Canadian International Film Co., is now taking about 150 h.p. in Trenton. This Company, which is producing Canadian motion pictures is directed by Captain Bruce Bairnsfather, whose war cartoons are so well known.

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A number of extensions are now being made in the rural districts on the Central Ontario System. More favorable rates in these districts have had the effect of greatly increasing a business which has been more or less dormant for many years.

* * * *

Georgian Bay System

A great deal of activity has been manifested in rural districts throughout the Georgian Bay System during the past few months. Indications are that several new rural power districts will be opened up during the coming year to give service to a large number of farm and hamlet customers throughout the area covered by this system.

* * * *

Construction of rural lines in Beaumauris Rural Power District has been progressing for several weeks and most of the poles will be set before the winter weather closes down the work. The area served is in the centre of the Muskoka summer resort district and comprises a large section of same. About eighty farms and summer residences will be served, it being planned to have the work completed and the lines in service about June 1st, 1928.

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Arrangements are well under way for serving the hamlet of Holland Centre, located on the main transmission line between Eugenia and Owen Sound in Chatsworth Rural Power District. About twenty hamlet customers will be served direct from a transformer stepping down from 22,000 to 110-220 volts; that is, there will be only one transformation from high tension to distribution voltage. Negotiations are also under way for supplying power in the hamlet of Berkeley, about 3½ miles south from Holland Centre in the same manner, where about eighteen hamlet customers will be served.

A rural line has been constructed out of Kilsyth Station in Derby Twp. in the vicinity of Owen Sound, and service was given to about 25 farm and hamlet customers during the early part of December. In the same district the lines out of the village of Tara have been extended to serve several additional farm customers.

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Niagara System

On account of the growth of load in North York Township and in the Rural Power District served from this point, the transformer capacity of York Mills Station has been doubled, the present total being 900 kv-a.

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New transformers have been installed in the Simcoe Municipal Station, there being now 3—500 kv-a. units replacing transformers that had a total capacity of 600 kv-a., the original capacity of this station was 300 kv-a.

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The town of Weston is rebuilding its distribution system, the amount of copper being increased and additional transformer capacity added. This has been made necessary by the growth of the domestic load in the municipality.

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There has been marked activity in Simcoe Rural Power District during the past year, in the growing of flue cure tobacco. This has resulted in increase of use of hydro-electric power on account of irrigation and green-house work.

A new distributing station containing 3—75 kv-a. units has been placed in service at Thamesford. This station serves the load in Thamesford and parts of the Dorchester R.P.D. and Ingersoll R.P.D.

Association of Municipal Electrical Utilities

Officers for 1928.

The election ballots for officers of the Association of Municipal Electrical Utilities for the year 1928, will show the following names as candidates for the various offices :—

President—J. G. Archibald.
Vice-President—W. R. Catton.
A. W. J. Stewart.
Secretary—S. R. A. Clement.
Treasurer—D. J. McAuley.
Directors—E. V. Buchanan
J. G. Jackson
V. S. McIntyre
J. E. B. Phelps
O. H. Scott
E. J. Stapleton

District Directors.
Niagara District—H. G. Hall,
J. E. Teckoe.
Georgian Bay District—
H. Campbell,
J. R. McLinden.
Central District—C. T. Barnes,
V. B. Coleman
Eastern District—R. J. Smith.
Northern District—
T. W. Brackinreid,
C. J. Moors.

The Ballots will be given to the delegates on the morning of the first day of the Convention and will be

returned immediately after the opening of the first session so that the results of the election can be announced before that session closes.

List of Electrical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in November, 1927.

Appliances

THE A. S. BOYLE COMPANY, 146 Brock Avenue, Toronto, Ont.

Electric Floor Polisher.

* * * *

BRAUN AND BONNICK LIMITED, 78 Duchess Street, Toronto, Ont.

"Peerless" Portable Floor Polishing Machine.

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ELECTRIC LIVE LINE SIGNS LIMITED, 9 Wellington St., E., Toronto, Ont.

Electrically - illuminated Window Display Sign.

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GILSON MANUFACTURING CO., LIMITED, Guelph, Ont.

"Snow-Bird." Portable Motor-operated Washer and Wringer, Dolly type, wood or metal tub ; Gyrator type, aluminum tub.

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GLOBE MANUFACTURING COMPANY, Battle Creek, Mich.

Motor-operated Air Compressors. Type 27.

* * * *

INVINCIBLE VACUUM CLEANER MFG. CO., Dover, Ohio.

"Invincible Universal Truck." Vacuum Cleaner, commercial use.

PAUL E. JOHNSON INC., 1824-30 S. Albert St., Chicago, Ill.

Portable electric therapeutic lamp. Model A.

* * * *

WAGNER ELECTRIC MANUFACTURING COMPANY OF CANADA, LIMITED, 183 George St., Toronto.

Polyphase Starterless Motors.

* * * *

*NATIONAL REFRIGERATING CO., 125 Munson St., New Haven, Conn.

"Ice-O-Lator." Household refrigerating machine.

Marking : "Ice-O-Lator" Model "E" or "G", serial number, current rating, and name and address of manufacturer.

Fittings

FITTINGS LIMITED, Oshawa, Ont.

Cast-iron conduit fittings, Types A. B. C. E. F. LB, LL, LR and T.

Cast-iron conduit boxes, Types G, H, J, K, and FS.

"Fittings Limited."

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*CURTIS LIGHTING, INC., 1119 W. Jackson Blvd., Chicago, Ill.

"CurtiStrip and X-Raylet" fixture parts and fittings (As listed on Underwriters' Laboratories card dated August 5, 1927.)

*Fitzgerald Mfg., Co., The, Winsted, Conn.

Composition attachment plug for use with portable heating appliances.

Cat. No. 493.

Marking : "Star-Rite."

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*Reynolds Spring Co., Jackson, Mich.

Current Taps. Multiple type, keyless, Cat. Nos. 240, 340, 360 and 380.

Marking : "Reynolite" and electrical rating.

Receptacles, single and duplex types, Cat. Nos. 4001 and 4002.

Attachment plugs, fuseless, Cat. No. 500.

Separable attachment plug, Cat. Nos. 420 and 495.

Marking : "Reynolite" and rating molded in face of plug.

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*Gaynor Electric Co., Inc., Bridgeport, Conn.

Receptacles for Attachment Plugs and Plugs. Cat. Nos. 402, 452.

Marking : "Gaynor."

Miscellaneous

*Canadian General Electric Co. Limited, Toronto.

Two or multiple conductor cord. Type SJ.

Marking : One black cotton thread cable with strands.

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*Reynolds Spring Co., Jackson, Mich.

Cord sets including fuseless attachment plugs for use with portable heating appliances. Cat. No. 600.

Marking : "Reynolite" and rating molded in face of plug.

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* These devices are under the Underwriters' Laboratories re-examination or label service.

Re Municipal Populations

To enable the Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.—*Editor*.

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